

Tooele Army Depot - North Area

**Final
Feasibility Study
for
Operable Units 5, 6, 7, and 10**

March 1994

**Rust Environment and Infrastructure
Grand Junction, Colorado 81506**

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Acronyms/Abbreviations

APEG	alkaline metal polyethylene glycol
ARARs	Applicable or Relevant and Appropriate Requirements
BEST	Basic-Extraction Sludge Technology
BRA	Baseline Risk Assessment
BRAC	Base Realignment and Closure
BTU	British Thermal Unit
CERCLA	Comprehensive Environmental Response, Compensation, and Liability Act
cm/sec	centimeter per second
CRL	certified reporting limit
DMSO	dimethyl sulfoxide
DOE	Department of Energy
DOT	Department of Transportation
DRMO	Defense Reutilization and Marketing Office
EMO	Environmental Management Office
EPA	U.S. Environmental Protection Agency
FFA	Federal Facilities Agreement
Hc	Henry's Law Coefficient
HMX	cyclotetramethylenetetranitramine
HOCs	halogenated organic compounds
KPEG	potassium polyethylene glycolate
LF	linear feet
LDRs	land disposal restrictions
MCL	maximum contaminant level
µg/g	micrograms per gram
mg/l	milligrams per liter
mg/kg	milligrams per kilogram
NAAQs	National Ambient Air Quality Standards
NCP	National Oil and Hazardous Substances Pollution Contingency Plan
NOX	thermal nitrogen oxide
NPDES	National Pollutant Discharge Elimination System
NPL	National Priority List
NRC	Nuclear Regulatory Commission
O&M	operation and maintenance
OSHA	Occupational Safety and Health Administration
OU	operable units
PAHs	polynuclear aromatic hydrocarbons
PCB	polychlorinated biphenyl
PCDDs	polychlorinated dibenzodioxins
PCDFs	polychlorinated dibenzofurans
ppm	parts per million
PW	present worth
RCRA	Resource Conservation and Recovery Act
RDX	cyclonite

Acronyms/Abbreviations (continued)

RFI	RCRA Facility Investigation
RI/FS	Remedial Investigation/Feasibility Study
RME	reasonable maximum exposure
RUMAC	rubber-modified asphalt concrete
Rust E&I	Rust Environment and Infrastructure
SARA	Superfund Amendments and Reauthorization Act
SDWA	Safe Drinking Water Act
semi-VOCs	semi-volatile organic compounds
SITE	Superfund Innovative Technology Evaluation
SVE	soil-vapor extraction
SWMUs	Solid Waste Management Units
SY	square yard
TBC	To Be Considered
TCDD	tetrachlorodibenzo-p-dioxin
TCLP	Toxicity Characteristic Leaching Procedure
TDF	tire-derived fuel
TEAD-N	Tooele Army Depot-North Area
TNT	trinitrotoluene
TSCA	Toxic Substances Control Act
TSD	treatment, storage, and disposal
UCL	upper confidence limit
USAEC	U.S. Army Environmental Center
USATHAMA	U.S. Army Toxic and Hazardous Materials Agency
UXO	unexploded ordnance
VOCs	volatile organic compounds

EXECUTIVE SUMMARY

Tooele Army Depot North Area (TEAD-N) is a National Priorities List (NPL) site under the U.S. Environmental Protection Agency (EPA) Superfund program. As such, a Remedial Investigation/Feasibility Study (RI/FS) must be performed. There are 7 operable units containing 17 sites at TEAD-N that are under the Superfund program. Rust Environment and Infrastructure (Rust E&I, formerly SEC Donohue, Inc.), under a U.S Army Environmental Center (USAEC, formerly U.S. Army Toxic and Hazardous Materials Agency (USATHAMA)) contract (Contract No. DAAA15-90-D-0007, Task Order 0003), was tasked with conducting the RI/FS for TEAD-N. The RI/FS is being conducted in accordance with the requirements of a Federal Facilities Agreement (FFA) between EPA Region VIII, State of Utah Department of Environmental Quality, and Tooele Army Depot. The FFA establishes the appropriate regulatory requirements and schedule for completing the RI/FS.

The operable units (OUs) and associated sites that are being investigated are shown in Table ES-1. Throughout this document, individual areas will be referred to as sites; in future documents, the designation Solid Waste Management Unit (SWMU) will be used.

Table ES-1. Operable Units and Sites at TEAD-N

Operable Unit	Site No.	Site Name
4	31*	Former Transformer Boxing Area
	32*	PCB Spill Site
	35	Wastewater Spreading Area
5	17	Former Transformer Storage Area
	33	PCB Storage Building 659
6	9	Drummed Radioactive Waste Area
	18	Radioactive Waste Storage Building
7	5	Pole Transformer PCB Spill
8	6*	Old Burn Area
	7*	Chemical Range
	13*	Tire Disposal Area
	22	Building 1303 Washout Pond
	23	Bomb and Shell Reconditioning Building
9	36*	Old Burn Staging Area
	8	Small Arms Firing Range
	40	AED Test Range
10	41	Box Elder Wash Drum Site

*Sites 31 and 32 were originally placed in OU 5; Sites 6, 7, 13, and 36 were in OU 7.

Based on the information compiled during the RI and subsequent discussions between the EPA, State of Utah, and USAEC, it was decided that additional data are needed on 11 of the

above 17 sites before an FS can be completed. As a result, this FS covers only the six sites shown in Table ES-2.

Table ES-2. Sites Covered in Feasibility Study

Operable Unit	Site No.	Site Name
5	17	Former Transformer Storage Area
	33	PCB Storage Building 659
6	9	Drummed Radioactive Waste Storage Area
	18	Radioactive Waste Storage Building
7	5	Pole Transformer PCB Spill
10	41	Box Elder Wash Drum Site

The purpose of the FS is to provide decision makers with the information necessary to select a remedy for each site that will be protective of human health and the environment. To that end, this document outlines possible remedial technologies evaluated for the various sites. The preferred alternative recommended for each site will be presented in the Proposed Plan. Each site is individually addressed as follows:

1. Site Description, including location maps and historical data
2. Nature and Extent of Contamination, including identification of contaminants of concern
3. Contaminant Fate and Transport
4. Summary of the Baseline Risk Assessment
5. Remedial-Action Objectives
6. General Response Actions
7. Identification and Screening of Remedial Technologies, according to effectiveness, implementability, and cost
8. Development of Remedial Alternatives
9. Detailed Analysis of Alternatives, using the nine evaluation criteria established by the National Oil and Hazardous Substances Pollution Contingency Plan (NCP)
 - a. Overall protection of human health and the environment
 - b. Compliance with Applicable or Relevant and Appropriate Requirements (ARARs)
 - c. Long-term effectiveness and permanence
 - d. Reduction of toxicity, mobility, or volume through treatment
 - e. Short-term effectiveness
 - f. Implementability
 - g. Cost
 - h. State acceptance
 - i. Community acceptance
10. Comparative Analysis of Remedial Alternatives (when applicable)

The following summarizes the six sites covered in this FS.

Former Transformer Storage Area (Site 17)

The Former Transformer Storage Area (Site 17) refers to Open Storage Lot No. 675B in the northern portion of the Maintenance Area of TEAD-N. Before 1979, this graveled lot was used for long-term storage of electrical transformers and capacitors. In 1979, all of the transformers were removed from the lot. Following removal of the transformers, composite surface-soil samples were collected and analyzed for polychlorinated biphenyls (PCBs). The results showed that low concentrations of PCBs were present in the soils at Site 17.

It was determined, after further review of the existing data, that no further sampling of the site soils was required. A baseline risk assessment was performed utilizing the existing PCB data to evaluate risks associated with this site. All scenarios for carcinogenic risks were within or below the EPA target range of $1\text{E-}4$ to $1\text{E-}6$ for residual risk. Chronic, noncarcinogenic risk estimates for Site 17 meet the EPA goal for a residual hazard index of 1 or less for both the average exposure and reasonable maximum exposure (RME) case.

Soils: Beginning with six possible general response actions for soils, the following six remedial alternatives were retained for consideration:

- No Action
- Institutional Controls
- Soil Cover
- Stabilization
- Landfill Disposal
- Incineration

Groundwater: Similarly, four response actions were evaluated for potential groundwater remediation. Leaching of PCBs to the groundwater at Site 17 is unlikely because the groundwater is approximately 280 feet below grade, the concentrations of PCBs detected in soil are low, and PCBs are relatively immobile in soil. In addition, PCB soil cleanup values based on direct contact assumptions will generally provide sufficient protection to human health and the environment from possible groundwater contamination. Therefore, only the No Action alternative is retained for further consideration for the groundwater.

PCB Storage Building 659 (Site 33)

The PCB Storage Facility began receiving transformers in 1979 when the transformers at Site 17 were moved to Building 659 for long-term storage. The facility is a Toxic Substances Control Act (TSCA)-permitted facility for the storage of PCB-contaminated transformers. The building has a concrete floor, perimeter berm, and diversion structures at the entrance areas to contain any spills. The facility appeared to be in good condition and well maintained

at the time of the RI field investigation. Facility operation is conducted in compliance with a Toxic Substances Control Act (TSCA) permit. There is no evidence or data to indicate PCB-contaminated wastes have been released from the building to the environment in the vicinity of Building 659. As detailed in Appendix C, suspect PCB contamination from as early as 1981 was shown to be non-existent.

Because Building 659 is a TSCA-permitted facility that is monitored and well maintained, no investigations were conducted during the RI at Site 33. As long as the facility remains under Army control with TSCA permits in place, there is little likelihood of contamination occurring. If this facility were to be changed from PCB storage or transferred from Army control, a complete examination and re-evaluation would take place prior to any such transfer under TSCA rules and Base Realignment and Closure (BRAC) regulations, thus ensuring continued protection of human health and the environment. Because there are no indications of a contaminant release at Site 33, No Action is the only remedial action considered.

Drummed Radioactive Waste Storage Area (Site 9)

The Drummed Radioactive Waste Storage Area (Site 9) consists of two areas that were previously identified as having been used for the storage of one or more 55-gallon drums containing low-level radioactive waste. The exact location where the materials may have been stored had never been determined, and no investigations had been conducted. Although radioactive releases were possible, no releases had been reported at Site 9.

During the RI, a surface radiation survey of the two suspect areas of drum storage was conducted to determine if a release of radioactive materials had occurred. The first small area was scanned over its entire surface with no radioactivity above background being detected. The second larger area was gridded and each grid line was scanned for beta/gamma radiation. Further, the alpha decay energies for all isotopes that possibly could have been stored on site were high enough to be detected by the instrument used. Again, no areas of radioactivity above background were detected during the survey.

As a result of the radiation surveys, it has been determined that no further investigation of this site is warranted, and No Action is the only remedial alternative considered.

Radioactive Waste Storage Building (Site 18)

The Radioactive Waste Storage Building (Site 18) is located on the northern end of Building 659, which also houses transformers (Site 33). This radioactive storage portion of the building is walled off and locked. The storage area is a Nuclear Regulatory Commission (NRC)-licensed facility for the storage of radioactive materials. Low-level radioactive materials are stored in this area. Access to the materials is controlled, and periodic monitoring of the facility for releases of radioactive materials is performed.

No previous investigations had been conducted at this facility before the RI. After a site visit in 1992, it was determined that no investigation at this facility was warranted. This facility is

an active, licensed facility that is locked, well maintained, and monitored. If the facility were to be transferred from Army control in the future, a BRAC investigation would be undertaken to ensure continued protection of human health and the environment. Therefore, No Action is the only remedial alternative considered for this site.

Pole Transformer PCB Spill (Site 5)

The Pole Transformer PCB Spill (Site 5) is the site of a pole-mounted electrical transformer that caught on fire and spilled PCB-contaminated oil on the surrounding soils. The contaminated soils were excavated, placed in 55-gallon drums, and disposed of off-site. No soil samples were collected from the excavation to verify that the cleanup was complete. However, a composite sample of the drummed soils was collected and analyzed for PCBs. The results showed that the composite concentration of PCBs was 3.45 micrograms per gram ($\mu\text{g/g}$).

During the current RI, surface- and subsurface-soil samples were collected along the perimeter of the excavation, and a subsurface soil sample was collected in the center of the excavation to determine if residual PCB contamination is present in the soils and, if present, whether the contaminants pose a risk to human health and the environment. Results of the sampling and analysis indicate that low levels of PCBs, polychlorinated dibenzofurans, and polychlorinated dibenzodioxins are present in the soils in and adjacent to the excavation.

Results of the baseline risk assessment indicate that carcinogenic risks associated with Site 5 are within or below the EPA target range for residual risk. Chronic, noncarcinogenic risk estimates meet the EPA goal for a residual hazard index of 1 or less for all scenarios evaluated. Since health-based levels are not exceeded, it appears that no further investigation of the site is warranted.

Soils: Six general response actions were evaluated and several potential remedial technologies were identified and screened, resulting in the following six remedial alternatives being retained for further consideration for Site 5 soils:

- No Action
- Institutional Controls
- Soil Cover
- Stabilization
- Landfill Disposal
- Incineration

Groundwater: No groundwater contamination data exist for Site 5. A potential may exist for contamination of the groundwater through leaching of the soil by infiltration of precipitation. However, because PCBs tend to adsorb strongly to soils, thus minimizing leaching, and because the estimated depth to groundwater below Site 5 is over 300 feet, it is

unlikely that groundwater contamination would occur. As a result, only the No Action alternative is considered for Site 5 groundwater.

Box Elder Wash Drum Site (Site 41)

Twenty-one drums are present in the channel of Box Elder Wash (Site 41). The source of the drums and the date of the dumping are unknown. The drums contain what appears to be tar. Previous investigation of the drum contents included sampling of four of the exposed and open drums. Results from the previous sampling showed the presence of several semi-volatile organic compounds, barium, and mercury.

RI investigations at the drum site included geophysical surveying to locate potential buried drums, hand excavation and inventory of all drums in the wash, collection of samples from eight drums, collection of surface and subsurface soils from hand-augered borings adjacent to the drums, collection of surface soils downstream from the drum site, and collection of a sample from a surface tar spill above the drum site.

Drum samples contained numerous metals, volatile organic compounds, and anions. In addition, two explosives, cyclotetramethylenetetranitramine (HMX) and nitrobenzene, were detected at low concentrations. HMX was present at 1.8 $\mu\text{g/g}$ and nitrobenzene ranged from 1.15 $\mu\text{g/g}$ to 2.49 $\mu\text{g/g}$. The drum samples were also analyzed for Toxicity Characteristic Leaching Procedure (TCLP) metals. Results showed metal concentrations did not exceed EPA regulatory levels.

Samples taken from subsurface soils contained no detectable concentrations of contaminants. Pyrene was detected at 0.99 $\mu\text{g/g}$ in one surface soil sample and nickel was detected at 48 $\mu\text{g/g}$ in the sample from the surface tar spill. All other surface soil samples contained no evidence of contamination.

Results of the baseline risk assessment for Site 41 soils (assuming removal of the drums and stained soils) indicate that carcinogenic and chronic, noncarcinogenic risks to human health are below EPA target levels for all scenarios.

Soil and Drums: Six general response actions were evaluated for the soil and drums at Site 41. From these, four remedial alternatives were retained for further consideration:

- No Action
- Institutional Controls
- Removal and Off-Site Incineration of Drums and Stained Soil
- Removal and Off-Site Disposal of Drums and Stained Soil

Surface and Groundwater: There are no analytical data for surface or groundwater for Site 41. A potential could exist for water contamination through leaching of soil by infiltration of precipitation. However, because of minimal soil contamination and because the estimated

depth to groundwater below Site 41 is 220 feet, surface water and groundwater contamination are unlikely. Therefore, No Action is the only water alternative considered for this site.

1.0 INTRODUCTION

1.1 PURPOSE

Rust Environment and Infrastructure (Rust E&I, formerly SEC Donohue, Inc.) is currently conducting a Remedial Investigation/Feasibility Study (RI/FS) at Tooele Army Depot-North Area (TEAD-N), Tooele, Utah (Figure 1-1). The scope of the RI/FS includes 17 sites located within 7 operable units (OUs) (Figure 1-2). The RI is designed to provide information on the nature and extent of contamination associated with sites within each OU and, on the basis of these data, evaluate and estimate the risks to human health and the environment as a result of the contaminants present. The FS is designed to assemble, evaluate, and compare remedial-action alternatives for each site utilizing the contaminant and risk information obtained during the RI. Based on information gathered during the RI and subsequent review by the U.S. Environmental Protection Agency (EPA), State of Utah, and the U.S. Army Environmental Center (USAEC), it was decided that additional sampling and characterization are required for 11 of the 17 sites. As a result, this FS addresses only six sites as follows:

- Site 17, Former Transformer Storage Area (OU 5)
- Site 33, PCB Storage Building 659 (OU 5)

- Site 9, Drummed Radioactive Waste Storage Area (OU 6)
- Site 18, Radioactive Waste Storage Building (OU 6)

- Site 5, Pole Transformer PCB Spill Site (OU 7)

- Site 41, Box Elder Wash Drum Site (OU 10)

These sites are identified on Figure 1-3.

The remaining 11 sites, which will be addressed in future documents after additional sampling and characterization are completed, are:

- Site 31, Former Transformer Boxing Area (OU 4)
- Site 32, PCB Spill Site (OU 4)
- Site 35, Wastewater Spreading Area (OU 4)

- Site 6, Old Burn Area (OU 8)
- Site 7, Chemical Range (OU 8)
- Site 13, Tire Disposal Area (OU 8)
- Site 22, Building 1303 Washout Pond (OU 8)

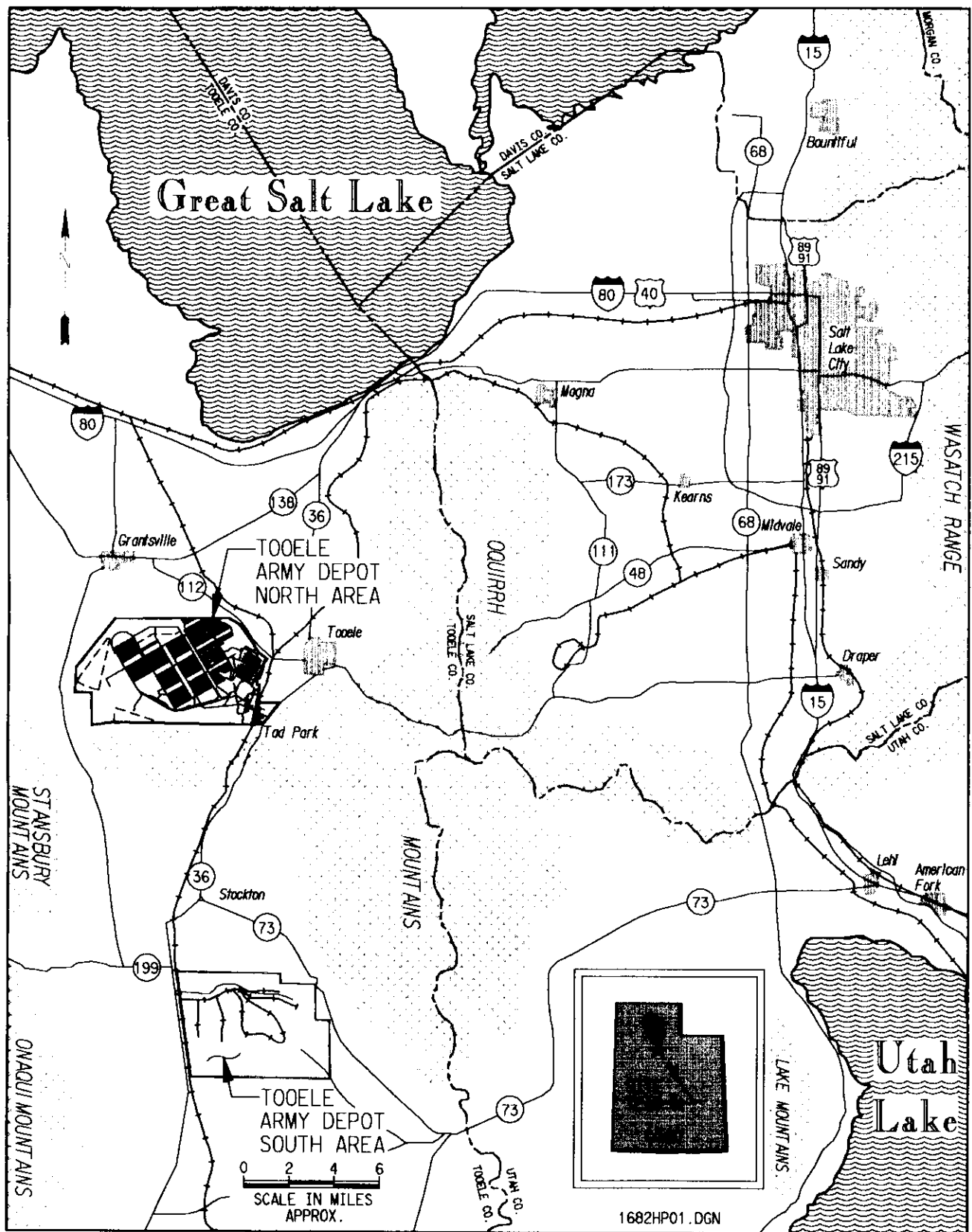
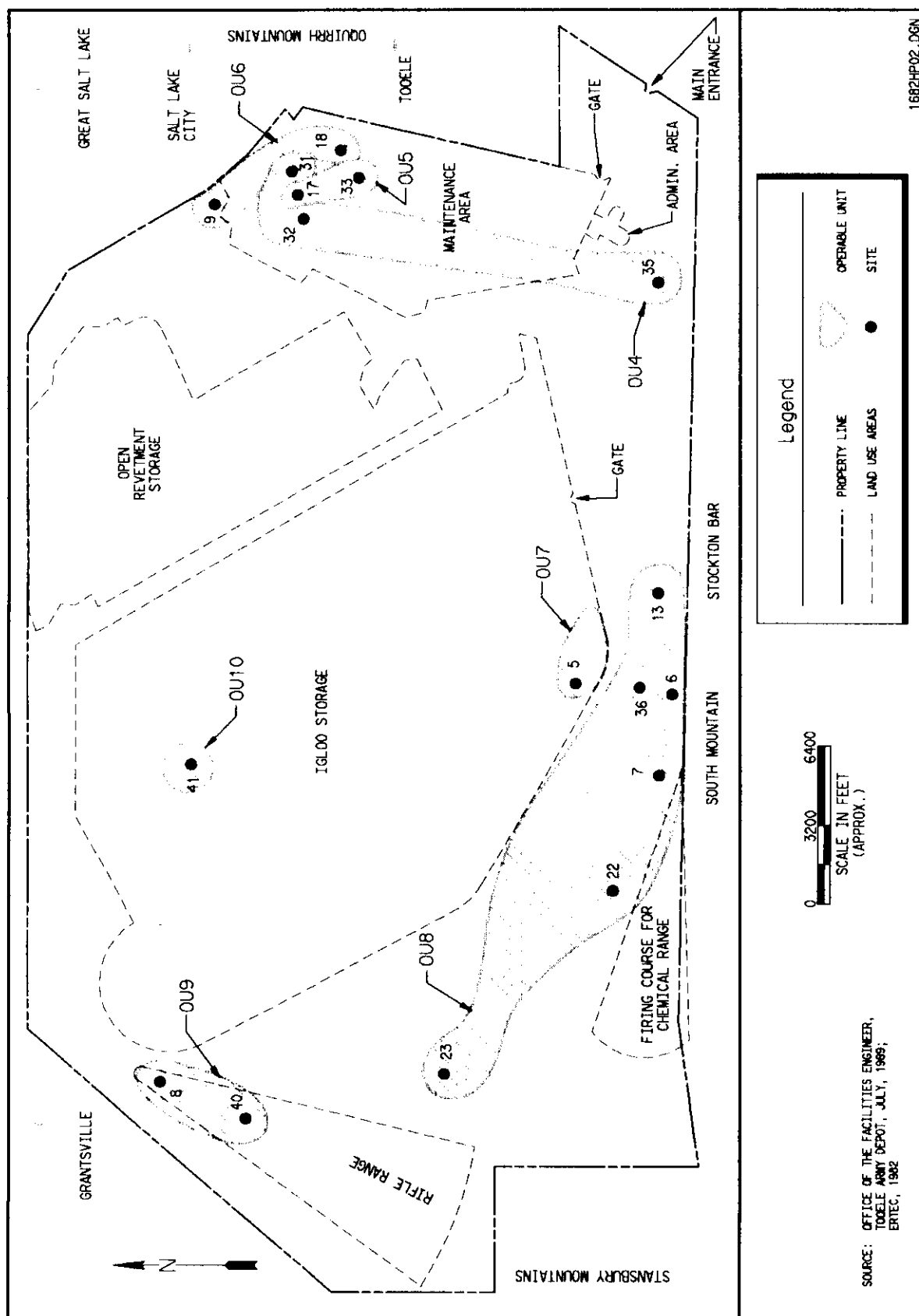


Figure 1-1. Location Map of Tooele Army Depot-North Area and Vicinity



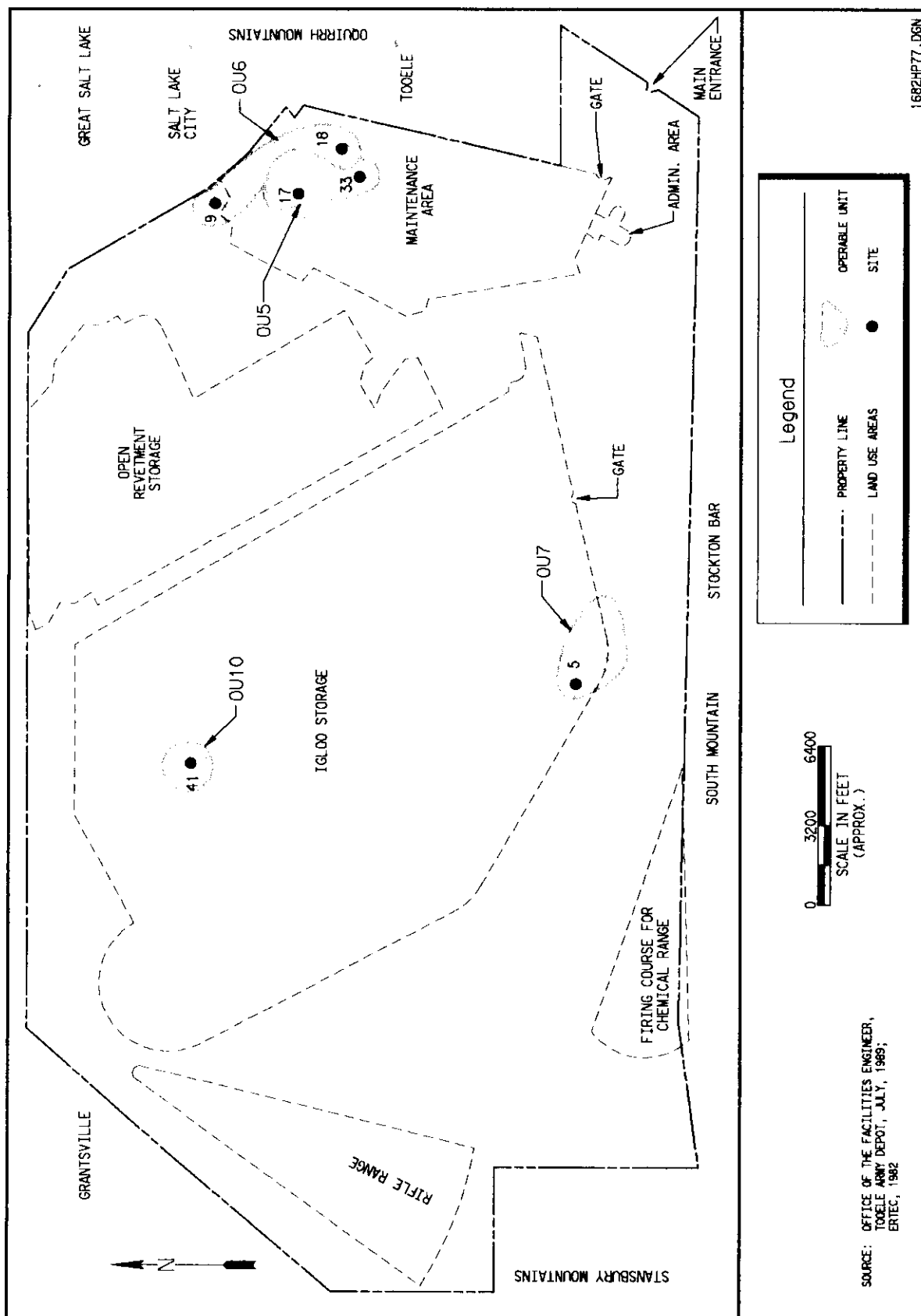


Figure 1-3. Location Map of Operable Units and Sites at Tooele Army Depot-North Area Covered in This Feasibility Study

- Site 23, Bomb and Shell Reconditioning Building (OU 8)
- Site 36, Old Burn Staging Area (OU 8)
- Site 8, Small Arms Firing Range (OU 9)
- Site 40, AED Test Range (OU 9)

(Please note the rearranging of some sites within OUs from that shown in previous documents. Sites 31 and 32 were in OU 5; Sites 6, 7, 13, and 36 were in OU 7.)

A change has been made in the nomenclature used in OUs 4 through 10. Up through the time of publication of this FS report and the RI report, all investigated areas were designated as "sites." Beginning with the Proposed Plan and for all subsequent documents, these same areas will be identified as Solid Waste Management Units (SWMUs).

1.2 GENERAL BACKGROUND

TEAD-N is located 35 miles southwest of Salt Lake City and encompasses 24,732 acres in the Tooele Valley, Tooele County, Utah (Figure 1-1). The facility was established in 1942 and has been one of the major ammunition storage and equipment-maintenance installations in the U.S. Until recently, the missions of TEAD-N have been to receive, store, issue, maintain, and dispose of munitions; to provide installation support to attached organizations; and to operate other facilities as assigned. A recent change envisions that the maintenance area of TEAD-N will be utilized for industrial purposes by private firms or other government entities.

As a result of continuous operations at TEAD-N since 1942, a variety of known or suspected waste and spill sites have been identified. Environmental investigations from the late 1970s to the present have resulted in the identification of 46 sites referred to as Solid Waste Management Units (SWMUs). In 1991, a Corrective Action Permit was issued to TEAD-N that required the Army to perform a Resource Conservation and Recovery Act (RCRA) Facility Investigation (RFI) at the 46 SWMUs. However, 17 of the 46 SWMUs have since been designated as Comprehensive Environmental Response, Compensation, and Liability Act (CERCLA) sites by the Environmental Protection Agency (EPA) and the State of Utah. These 17 sites were grouped into 7 OUs, numbered 4 through 10. Under CERCLA, the Army is required to perform an RI/FS for each OU at TEAD-N. As stated, 11 of the 17 sites are not addressed in this FS report because additional data were deemed necessary, based upon the results of the initial field investigation of those sites. Throughout this document, the SWMUs being investigated as part of the CERCLA OUs will be referred to as sites; in future documents, they will be referred to by the designation SWMU.

1.3 FEASIBILITY STUDY ORGANIZATION

The approach used in preparing this FS Report generally follows the EPA guidance presented in *Guidance for Conducting Remedial Investigations and Feasibility Studies Under CERCLA* (EPA, 1988a). Section 2.0, Remedial Technology Descriptions, is a reference section that provides a description of the remedial technologies that are evaluated as possible remediation alternatives at various sites. Subsections on each of the six sites (arranged by OUs in Sections 3 through 6) (1) describe the site; (2) summarize the nature and extent of contamination, including an identification of the contaminants of concern; (3) summarize the fate and transport characteristics of the contaminants; (4) summarize the Baseline Risk Assessment, including results from both the human health and the ecological risk assessment; (5) select remedial-action objectives and remediation goals; (6) identify general response actions; (7) identify and screen remedial technologies; (8) develop remedial alternatives, including a description of each remedial alternative that outlines the waste-management strategy involved and identifies the key Applicable or Relevant and Appropriate Requirements (ARARs); (9) provide a detailed analysis of each of the remedial alternatives; and (10) provide a comparative analysis of the alternatives.

1.3.1 Selection Process for Remedial-Action Objectives

The remedial-action objectives and remediation goals for each site are based on the results of site-specific risk assessments and any chemical-specific ARARs for the site. The remedial-action objectives for this FS are based on the assumption that TEAD-N will continue to function as an Army installation. For the six sites covered in this FS, four currently meet EPA human health and environmental protection guidelines. Site 5 in OU 7 and Site 41 in OU 10, if remediated as outlined in this FS, would also meet all human health and environmental guidelines. If transferred to other use, Sites 33 and 18—which are located in a single building used for polychlorinated biphenyl (PCB) and radioactive material storage—would require closure processes to be (1) regulated by current permitting agencies' regulations (Toxic Substances Control Act (TSCA) and Nuclear Regulatory Commission (NRC)) and (2) controlled by Army personnel under Base Realignment and Closure (BRAC) rules. A BRAC site investigation and risk assessment would be required.

Current base closure plans envision that the TEAD-N Maintenance Area, which includes Sites 17, 33, 9, and 18 covered in this FS, will be utilized for industrial purposes by private firms or other government entities. However, because of uncertainties over the future use of TEAD-N property, possible future residential use was evaluated where appropriate. The risks associated with possible future residential use of Sites 17, 9, 5, and 41 meet accepted EPA guidelines. As stated above, Sites 33 and 18 will undergo additional evaluation when it is decided to change their use from permitted/licensed storage of regulated materials.

1.3.2 Applicable or Relevant and Appropriate Requirements

A complete list of potential location-specific, chemical-specific, and action-specific ARARs for TEAD-N is presented in Table 1-1. This list was, for the most part, obtained through evaluation of two previously compiled TEAD documents cited below.

- *Draft Assessment of Chemical-Specific Applicable or Relevant and Appropriate Requirements (ARARs) for Tooele Army Depot, North and South Areas, Tooele, Utah (Oak Ridge National Laboratory, 1992a); and*
- *Draft Assessment of Location-Specific Applicable or Relevant and Appropriate Requirements (ARARs) for Tooele Army Depot, North and South Areas, Tooele, Utah (Oak Ridge National Laboratory, 1992b).*

These two documents discuss chemical-specific ARARs and location-specific ARARs for TEAD-N; both are included as Appendix A to this FS Report. Table 1-1 also includes potential ARARs identified after those presented in the documents in Appendix A. Pertinent location-specific and chemical-specific ARARs from Table 1-1 are discussed in the sections on remedial-action objectives for each site. Action-specific ARARs are identified in the remedial alternatives descriptions for each site.

1.3.3 Screening Criteria for Remedial Technologies

Remedial technologies are screened on the basis of effectiveness, implementability, and cost as described below. The technologies are screened for each site to produce an inventory of suitable technologies that can be assembled into remedial alternatives.

Effectiveness. Technologies must be suitable for the conditions of the site, must be suitable for the types and concentrations of contaminants, and must be effective in addressing the volume of contaminated media. The technology itself must not have substantial adverse impacts on the environment or human health. Another consideration is whether the technology is proven and reliable with respect to the remediation goals for the site. If the characteristics of site-related contaminants or site conditions clearly limit the effectiveness of a technology, the technology is eliminated.

Implementability. Implementability includes both the technical and administrative feasibility of implementing a technology. Considerations include the ability to obtain any necessary permits for off-site actions; the availability of treatment, storage, and disposal services (including capacity); and the availability of necessary equipment and skilled workers to implement the technology. The available area, accessibility, and potential future use of the site may affect the implementation of some technologies. Technologies that are not technically or administratively feasible are eliminated.

Table 1-1. ARARs for TEAD-N

Standard Requirements, Criteria, or Limitations	Citation	Description	Potentially Applicable/Relevant and Appropriate	Comments
SAFE DRINKING WATER ACT	42 U.S.C. 300f et seq.			
National Primary Drinking Water Regulations	40 CFR Part 141	Establishes health-based standards for public water systems (maximum contaminant levels (MCLs)).	Applicable - Chemical Specific	No evidence exists for contamination of surface water or groundwater at TEAD-N.
National Secondary Drinking Water Regulations	40 CFR Part 143	Establishes welfare-based standards for public water systems (Secondary maximum contaminant levels).	Applicable - Chemical Specific	No evidence exists for contamination of surface water or groundwater at TEAD-N.
CLEAN AIR ACT	42 U.S.C. 7401			
National Primary and Secondary Ambient Air Quality Standards	40 CFR Part 50	Establishes primary and secondary standards for six pollutants to protect public health and welfare.	Applicable - Chemical Specific	Proposed remedial actions will be in compliance with regulations.
SOLID WASTE DISPOSAL ACT				
Land Disposal Restrictions	40 CFR Part 268	Identifies hazardous wastes that are restricted from land disposal and describes those circumstances under which an otherwise prohibited waste may be land disposed.	Applicable - Chemical Specific, Action Specific	May apply depending on final remedial alternatives selection.
Underground Injection Control Program	40 CFR Parts 144-147	Provides for protection of underground sources of drinking water.	Relevant and Appropriate - Chemical Specific, Action Specific	No underground injections will take place under proposed remedial alternatives.

Table 1-1. ARARs for TEAD-N (continued)

Standard Requirements, Criteria, or Limitations	Citation	Description	Potentially Applicable/Relevant and Appropriate	Comments
TOXIC SUBSTANCES CONTROL ACT (TSCA)	15 U.S.C. 2601 et seq.			
(PCB) Storage and Disposal	40 CFR Part 761 Subpart D	Requirements for storage and disposal of PCBs including incineration.	Applicable - Chemical Specific	Proposed remedial actions will be in compliance with regulations.
PCB Waste Disposal Records and Reports	40 CFR 761 Subpart K	Requirements for PCB waste disposal records and reports.	Applicable - Chemical Specific	Proposed remedial actions will be in compliance with regulations.
PCB Spill Cleanup Policy	40 CFR Part 761 Subpart G	Criteria for determining adequacy of PCB spill cleanup.	Applicable - Chemical Specific, Action Specific	Proposed remedial actions will be in compliance with regulations.
EPA GUIDANCE ON REMEDIAL ACTIONS FOR SUPERFUND SITES WITH PCB CONTAMINATION	OSWER Directive No. 9355.4-01 (EPA/540/G-90 007) August 1990	Recommends approach for evaluation and remediation of PCB contaminated sites and suggests PCB cleanup goals.	To Be Considered - Chemical Specific	PCB guidance will apply for some remedial alternatives.
CLEAN WATER ACT	33 U.S.C. 1251-1376			
National Pollutant Discharge Elimination System (NPDES)	40 CFR Parts 122 and 125, and 230-231	Requires permits for discharge of NPDES pollutants from any point source into waters of the United States.	Relevant and Appropriate - Chemical Specific, Location Specific	Proposed remedial actions will not involve point source discharges into U.S. waters.

Table 1-1. ARARs for TEAD-N (continued)

Standard Requirements, Criteria, or Limitations	Citation	Description	Potentially Applicable/Relevant and Appropriate	Comments
Effluent Guidelines and Standards for the Point Source Category	40 CFR Part 414	Requires specific effluent characteristics for discharge under NPDES permits.	Relevant and Appropriate - Chemical Specific, Location Specific	Proposed remedial actions will be in compliance with regulations.
General Pretreatment Regulation for Existing and New Sources of Pollution	40 CFR Part 403	Sets standards to control pollutants that pass through or interfere with treatment processes in public treatment works or that may contaminate sewage sludge.	Relevant and Appropriate - Chemical Specific	Proposed remedial actions will be in compliance with regulations.
Water Quality Standards	40 CFR Part 131	Sets criteria for water quality based on toxicity to human health.	Applicable - Chemical Specific	Proposed remedial actions will be in compliance with regulations.
Ambient Water Quality Criteria	40 CFR Part 131 Subpart D	Sets criteria for ambient water quality based on toxicity to aquatic organisms.	Applicable - Chemical Specific	Proposed remedial actions will be in compliance with regulations.
UTAH WATER QUALITY ACT	19-5-101	Groundwater Protection R317-6.	Applicable - Chemical Specific	Proposed remedial actions will be in compliance with regulations.
UTAH SOLID WASTE MANAGEMENT ACT	19-6-501	Standards for Cleanup R315-101.	Applicable - Chemical Specific	Proposed remedial actions will be in compliance with regulations.
UTAH SOLID AND HAZARDOUS WASTE ACT	19-6-101	Permitting and Management requirements R315-1 through R315-101; Standards for cleanup R315-101.	Applicable - Chemical Specific, Action Specific	Proposed remedial actions will be in compliance with regulations.

Table 1-1. ARARs for TEAD-N (continued)

Standard Requirements, Criteria, or Limitations	Citation	Description	Potentially Applicable/Relevant and Appropriate	Comments
UTAH SAFE DRINKING WATER ACT	19-4-101	Water Quality (MCLs) R309-103.	Applicable - Chemical Specific	Proposed remedial actions will be in compliance with regulations.
RADIATION PROTECTION STANDARDS	10 CFR Part 20	Establishes permissible levels of radiation in unrestricted areas and waste disposal requirements.	Relevant and Appropriate - Chemical Specific, Location Specific	No evidence exists for radioactive contamination at TEAD-N.
SOLID WASTE DISPOSAL ACT				
Groundwater Protection	40 CFR 264.90 - 264.101	Establishes standards for pollutants that will, or are likely to, enter into groundwater.	Applicable - Chemical Specific	Proposed remedial actions will be in compliance with regulations.
UTAH GROUNDWATER PROTECTION RULES	Utah Administrative Code R317-6	Establishes standards for protection of groundwater quality.	Applicable - Chemical Specific	Proposed remedial actions will be in compliance with regulations.
UTAH POLLUTION DISCHARGE ELIMINATION SYSTEM	UAC R317-8	Governs introduction of pollutants to surface waters.	Relevant and Appropriate - Chemical Specific, Location Specific	Proposed remedial actions will not involve point source discharge to regulated waters.
UTAH UST TECHNICAL STANDARDS	UAC R311-202	Sets technical standards and corrective action requirements for owners and operators.	Relevant and Appropriate - Action Specific	Proposed remedial actions will not include UST corrective action.
PROTECTION OF BALD AND GOLDEN EAGLES	16 U.S.C. 668-668d	Protects identified species.	Applicable - Location Specific	Proposed remedial actions will be in compliance with regulations.

Table 1-1. ARARs for TEAD-N (continued)

Standard Requirements, Criteria, or Limitations	Citation	Description	Potentially Applicable/Relevant and Appropriate	Comments
PROTECTION OF MIGRATING GAME AND INSECTIVOROUS BIRDS	16 U.S.C. 701-718h	Protects identified species.	Applicable - Location Specific	Proposed remedial actions will be in compliance with regulations.
NATIONAL HISTORIC PRESERVATION ACT	49 U.S.C. 470 40 CFR 6301(b) 36 CFR Part 800	Establishes standards for designating and maintaining structures of historical importance.	Applicable - Location Specific	Proposed remedial actions will be in compliance with regulations.
ENDANGERED SPECIES ACT	U.S.C. 1531 50 CFR Parts 200 and 402	Requires action to conserve endangered species within critical habitats upon which endangered species depend (includes consultation with the U.S. Department of the Interior).	Applicable - Location Specific	Proposed remedial actions will be in compliance with regulations.
ARCHEOLOGICAL AND HISTORICAL PRESERVATION	16 U.S.C. 469 40 CFR 6301(c)	Establishes procedures to provide preservation of historical and archeological data which might be destroyed through alteration of terrain as a result of a federal construction project or a federally licensed activity or program.	Applicable - Location Specific	Proposed remedial actions will be in compliance with regulations.

Table 1-1. ARARs for TEAD-N (continued)

Standard Requirements, Criteria, or Limitations	Citation	Description	Potentially Applicable/Relevant and Appropriate	Comments
HISTORIC SITES, BUILDINGS AND ANTIQUITIES ACT	16 U.S.C. 461-467 40 CFR 6301(a)	Requires federal agencies to consider the existence and location of landmarks on the National Registry of Natural Landmarks to avoid undesirable impacts on such landmarks.	Applicable - Location Specific	Proposed remedial actions will be in compliance with regulations.
FISH AND WILDLIFE COORDINATION ACT	166 U.S.C. 661-666	Requires consultation when a federal department or agency proposes or authorizes any modification of any stream or other water body, and adequate provision for protection of fish and wildlife resources.	Applicable - Location Specific, Action Specific	Proposed remedial actions will not affect any stream or water body at TEAD-N; no lakes or perennial streams exist at the site.
ENDANGERED AND THREATENED WILDLIFE AND PLANTS (1992)	50 CFR 17.11 and 17.12	List of endangered and threatened plants and wildlife.	Applicable - Location Specific	Proposed remedial actions will be in compliance with regulations.
AMERICAN INDIAN RELIGIOUS FREEDOM ACT	42 U.S.C. 1996 43 CFR 7	Protection of sites or artifacts associated with current Indian or other traditional, religious practices, rites, or ceremonies.	Applicable - Location Specific	Proposed remedial actions will be in compliance with regulations.

Table 1-1. ARARs for TEAD-N (continued)

Standard Requirements, Criteria, or Limitations	Citation	Description	Potentially Applicable/Relevant and Appropriate	Comments
SOLID WASTE DISPOSAL ACT				
Criteria for Classification of Solid Waste Disposal Facilities and Practices	40 CFR Part 257	Establishes criteria for use in which solid waste disposal facilities and practices pose a reasonable probability of adverse effects on public health or the environment, and thereby constitute prohibited open dumps.	Relevant and Appropriate - Location Specific, Chemical Specific	Remedial alternatives that address soil removal would require disposal in an approved hazardous waste landfill.
Standards Applicable to Generators of Hazardous Waste	40 CFR Part 262	Establishes standards for generators of hazardous waste.	Relevant and Appropriate - Action Specific, Location Specific	Proposed remedial actions will be in compliance with regulations.
Standards Applicable to Transporters of Hazardous Waste	40 CFR Part 263	Establishes standards that apply to transporters of hazardous waste within the U.S. if the transportation requires a manifest under 40 C.F.R. Part 262.	Relevant and Appropriate - Action Specific	Would apply to offsite treatment and/or disposal of soil
Standards for Owners and Operators of Hazardous Waste Treatment, Storage and Disposal (TSD) Facilities	40 CFR Part 264	Establishes minimum national standards, which define the acceptable management of hazardous wastes for owners and operators of facilities that treat, store, or dispose.	Relevant and Appropriate - Action Specific	Proposed remedial actions will be in compliance with regulations. Includes Subpart O Standards for Incinerators.

Table 1-1. ARARs for TEAD-N (continued)

Standard Requirements, Criteria, or Limitations	Citation	Description	Potentially Applicable/Relevant and Appropriate	Comments
SOLID WASTE DISPOSAL ACT				
Use and Management of Containers	40 CFR 264 Subpart I	Provides standards for the condition, compatibility, management, inspection, containment, and closure for containers used in hazardous waste related activities.	Relevant and Appropriate - Action Specific	Potential exists for these regulations to apply for some remedial alternatives.
Waste Piles	40 CFR 264 Subpart L	Provides containment, design closure, and post-closure care requirements for facilities that treat or store hazardous wastes in piles.	Relevant and Appropriate - Action Specific	Potential exists for these regulations to apply for some remedial alternatives.
MIGRATORY BIRD TREATY ACT OF 1918	16 U.S.C. 703	Prohibits the taking, capture, killing, and processing of any migratory bird, their parts, or eggs.	Applicable - Action Specific	Proposed remedial actions will be in compliance with regulations.
CLEAN WATER ACT				
	33 U.S.C. 1251-1376			
Dredge or Fill Requirements	40 CFR Parts 230-231	Requires discharges to address impact of discharge or dredge or fill material on the aquatic ecosystem.	Relevant and Appropriate - Action Specific	Proposed remedial actions will not involve dredge and fill of soil; possibly grading, backfill, and/or excavation and approved landfill disposal.

Table 1-1. ARARs for TEAD-N (continued)

Standard Requirements, Criteria, or Limitations	Citation	Description	Potentially Applicable/Relevant and Appropriate	Comments
USAEC GUIDELINES AND POLICIES:				
Department of the Army Ammunition and Explosives Safety Documents	USAT CESP 385-02	UXO safety guidelines for explosives and ammunition.	Applicable - Action Specific	Proposed remedial actions will be in compliance with regulations.
Department of the Army Ammunition of Explosives Safety Standards	AR 385-64	UXO safety guidelines for explosives and ammunition.	Applicable - Action Specific	Proposed remedial actions will be in compliance with regulations.
Department of Defense Explosives Safety Board Directives	#6055.9	UXO safety guidelines for explosives and ammunition.	Applicable - Action Specific	Proposed remedial actions will be in compliance with regulations.
UTAH AIR CONSERVATION ACT	19-2-101	Fugitive Dust Control R307-1-3.1.8(A) R307-1-4.5.2(B) Particulates Emissions R301-1-3.2.	Applicable - Action Specific	Proposed remedial actions will be in compliance with regulations.
GENERAL				
	RCRA Section 3020	Regulates reinjection of hazardous wastes during remediation.	Relevant and Appropriate - Action Specific	Remedial actions do not involve reinjection of hazardous wastes.
	29 CFR 1910.120	OSHA Worker Safety.	Applicable - Action Specific	Where appropriate, proposed remedial actions will be in compliance with regulations.

Table 1-1. ARARs for TEAD-N (continued)

Standard Requirements, Criteria, or Limitations	Citation	Description	Potentially Applicable/Relevant and Appropriate	Comments
HAZARDOUS MATERIALS TRANSPORTATION ACT	29 CFR 1976 Subpart P	Excavation.	Applicable - Action Specific	Remedial actions that include excavations will be in compliance with regulations.
	40 CFR 190	Regulates cleanup of radioactively contaminated sites.	Relevant and Appropriate- Action Specific, Location Specific	No evidence exists for radioactive contamination at TEAD-N.
	40 CFR 440	Regulates discharges of radionuclides to surface waters.	Relevant and Appropriate-Action Specific	No evidence exists for radioactive contamination at TEAD-N.
	49 CFR Parts 107, 171-177	Regulates transportation of hazardous materials.	Applicable - Action Specific	Will apply to remediation alternatives that specify off-site treatment and/or disposal.
UTAH WASTE TIRE RECYCLING ACT	Title 26 Ch. 32A	Regulates how to store used tires.	Relevant and Appropriate - Action Specific	Tires from OU 7 Site 13 were previously removed from the site.
UTAH USED TIRE MANAGEMENT AMENDMENT (1993)	House Bill 213	Amendment to Title 26, Ch. 32A.	Relevant and Appropriate - Action Specific	Tires from OU 7 Site 13 were previously removed from the site.
EMISSIONS FOR AIR STRIPPERS AND SOIL VENTING	VAC R307-6	Grants de minimus exemption for soil venting and air strippers.	Relevant and Appropriate - Action Specific	Proposed remedial actions will be in compliance with regulations.

Cost. Cost plays a limited role in the screening of technologies. Technologies with extremely high costs relative to other technologies for the same general response action are eliminated.

1.3.4 Evaluation Criteria for Remedial Alternatives

The detailed analysis of alternatives consists of an analysis of each remedial alternative against the set of nine evaluation criteria established by the National Oil and Hazardous Substances Pollution Contingency Plan (NCP) (40 CFR 300.430). The analysis compares the remedial alternatives for each site using the same evaluation criteria as a basis for comparison. The nine evaluation criteria are:

1. Overall protection of human health and the environment. The assessment against this criterion describes how the alternative, as a whole, achieves and maintains protection of human health and the environment.
2. Compliance with ARARs. The assessment against this criterion describes how the alternative complies with ARARs, or if a waiver is required, and how a waiver is justified. The assessment also addresses other information from advisories, criteria, and guidance (To Be Considered guidance) from federal and state agencies.
3. Long-term effectiveness and permanence. The assessment of alternatives against this criterion evaluates the long-term effectiveness of alternatives in maintaining protection of human health and the environment after response objectives have been met.
4. Reduction of toxicity, mobility, or volume through treatment. The assessment against this criterion evaluates the anticipated performance of the specific treatment technologies that an alternative may employ.
5. Short-term effectiveness. The assessment against this criterion examines the effectiveness of alternatives in protecting human health and the environment during construction and implementation of a remedy until response objectives have been met.
6. Implementability. This assessment evaluates the technical and administrative feasibility of alternatives and the availability of required goods and services.
7. Cost. This assessment evaluates the capital and operation and maintenance (O&M) costs of each alternative.
8. State acceptance. This assessment reflects the preferences or concerns of the state about the alternatives.
9. Community acceptance. This assessment reflects the preferences or concerns of the community about the alternatives.

The final two criteria, state acceptance and community acceptance, will be evaluated following comment on the RI/FS report and will be included in the final decision-making process during preparation of the Proposed Plan and the Record of Decision for the six sites.

2.0 REMEDIAL TECHNOLOGY DESCRIPTIONS

This section identifies and describes the remedial technologies that are considered for the sites at TEAD-N. Table 2-1 lists the technologies. These technologies were identified based on a review of literature, vendor information, performance data, and experience in developing other feasibility studies. The technologies represent an array of existing processes, ranging from those commonly practiced to those still in the experimental stages of development. As discussed below in the technology descriptions, sheet piling and grout curtain containment are not technically implementable at TEAD-N because of the great depth to the confining layer (hundreds of feet) and the gravelly nature of the alluvium underlying the OUs. Similarly, soil flushing is not technically implementable at TEAD-N because of the great depth to groundwater (hundreds of feet) beneath the OUs. Detonation is not appropriate for the six sites in this FS because unexploded ordnance (UXO) is not present at these sites. These four technologies are, therefore, eliminated from consideration for the assembly of remedial alternatives.

2.1 NO ACTION

The NCP requires consideration of the no-action alternative during the FS. The no-action alternative references a site risk assessment and presents a baseline of performance with which to evaluate other alternatives. Site soils would be left in place under this alternative. The no-action alternative does not reduce the toxicity, mobility, or volume of any soil contamination that is present, except that which may occur through natural degradation processes. Generally, the no-action alternative is effective at meeting the remedial-action objectives only if contamination levels are in compliance with ARARs and do not pose an excessive human health or environmental risk.

2.2 INSTITUTIONAL CONTROLS

This alternative does not involve active remediation; site soils would be left in place. However, this alternative would limit the potential for human and fauna exposure to site contaminants by placing controls on access to the site. Typical controls include deed restrictions, fences or other barriers, warning signs, and regular surveillance. Institutional controls do not reduce the toxicity, mobility, or volume of any soil contamination that is present, except those which may occur through natural degradation processes.

Institutional controls may be effective at protecting human health and the environment and complying with ARARs if the site contaminants have low toxicity, very low mobility, or are present at low concentrations. Long-term enforcement of the institutional controls is necessary to maintain effectiveness. Institutional controls are readily implementable. Costs are generally minimal and depend on factors such as the amount of maintenance and surveillance necessary for the barrier to control site access and the frequency and type of sampling necessary for long-term monitoring, if any.

Table 2-1. Remedial Technologies for Tooele Army Depot-North Area

Technology/Action	Process
No Action	
Institutional Controls	Deed Restrictions
	Fences
	Sampling and Analysis
Containment	Sheet Piling ^(a)
	Grout Curtain ^(a)
	Surface-Runoff Controls
	Capping
In situ Treatment	Biodegradation
	Radio Frequency Heating
	Soil Flushing ^(b)
	Soil-Vapor Extraction
	Stabilization
	Vitrification
Excavation with On-Site Treatment and Disposal	Biological Treatment
	Chemical Extraction
	Dechlorination
	Detonation ^(c)
	Incineration
	Physical Separation
	Soil Washing
	Stabilization
	Thermal Desorption
	Volatilization/Venting

Table 2-1. Remedial Technologies for Tooele Army Depot-North Area (continued)

Technology/Action	Process
Excavation with Off-Site Treatment/Disposal	Incineration Landfill

^aEliminated from consideration. Not technically implementable because of the great depth to bedrock (hundreds of feet to 1,000 feet) and gravelly alluvium underlying the OUs.

^bEliminated from consideration. Not technically implementable because of the great depth to groundwater (hundreds of feet) beneath the OUs.

^cEliminated from consideration. UXO is not present at the six sites in this feasibility study.

2.3 CONTAINMENT

Containment technologies employ physical barriers to limit the mobility of soil contaminants. Containment technologies may include the following:

- Sheet Piling
- Grout Curtain
- Surface-Runoff Controls
- Capping

Because of the extreme estimated depth to solid bedrock (hundreds of feet to over 1,000 feet) and the gravelly nature of the alluvium underlying the OUs, sheet piling and grout curtain techniques would be impractical for limiting mobility of soil contamination where it may exist in the six sites covered in this FS. Consequently, these two remedial technologies are not considered further. Surface-runoff controls and capping techniques are discussed below.

2.3.1 Surface Runoff Controls

This containment technique would use surface grading, lined ditches, and/or pipes to reroute surface-water runoff around the contaminated area. This action would reduce the risk due to migration of soil contaminants to other environmental pathways by (1) reducing surface water transport of waste constituents through erosion and (2) reducing infiltration of storm water runoff into the contaminated soils and the subsequent leaching of contaminants from the soils. Surface-runoff controls reduce the mobility of soil contaminants, but do not reduce the toxicity or volume of contaminants. Long-term maintenance of surface-runoff controls is necessary.

2.3.2 Capping

The general purpose of site capping is threefold: (1) to eliminate surface transport of waste constituents through erosion, (2) to eliminate the potential for direct contact (by humans, fauna, and flora) with waste material, and (3) to minimize infiltration of precipitation and the subsequent leaching of constituents from buried waste materials.

Capping is frequently used as a method of site remediation for a variety of waste materials, particularly when waste removal is impractical because of the risk of increased public exposure, the type of waste constituent, or the overall cost. A cover system may also be appropriate for capping residual soils after wastes and highly affected soils are removed. Capping reduces the mobility of soil contaminants but does not reduce the toxicity or volume of soil contaminants. Long-term enforcement of institutional controls (described in Section 2.2) and maintenance of the cap are necessary to protect the integrity of the cap.

The engineering of a cap is based on the contaminants of concern and site-specific conditions (e.g., the soil type, climate, topography, etc.). There are a number of different cap materials and designs available, including asphalt or concrete caps. A few additional types of caps are described below.

2.3.2.1 Clay Caps

This technology involves base preparation consisting of grading and compaction followed by placement and compaction of a clay layer to achieve a hydraulic conductivity on the order of 1×10^{-7} centimeter per second (cm/sec). A typical clay layer thickness is 2 feet. The clay layer is then covered with a topsoil layer and seeded to establish vegetation. The clay layer provides a low-permeability barrier that minimizes infiltration of precipitation through the wastes. Revegetation helps reduce surface erosion and minimize groundwater recharge by diversion and evapotranspiration of precipitation. Where minimization of direct contact with waste constituents is the primary concern, cover soils alone can be utilized (soil cap).

2.3.2.2 Synthetic Membranes

This technology involves grading the site, followed by placement of a synthetic liner sandwiched between two layers of sand. A layer of topsoil is then placed on top and seeded to establish vegetation. The bottom sand layer provides a cushion for the synthetic membrane, which is usually a flexible polymeric material. The sand layer above the membrane provides a drainage layer for infiltrated precipitation. The topsoil protects the membrane from surficial activities, while the vegetation provides erosion control. Synthetic membranes are most frequently used in conjunction with other cover media to form multi-media covers.

2.3.2.3 Multi-Media Covers

This technology involves placement of a clay layer with a permeability of 1×10^{-7} cm/sec over the waste. A synthetic membrane sandwiched between two sand layers is placed on top of the clay. Fill material to be seeded with shallow-rooted vegetation is then placed on top of the upper layer. This technology consists of two low-permeability liners to minimize infiltration, as well as sand layers to cushion the synthetic membrane and provide drainage.

The cost of installing a cap varies with the type of cap materials and ranges from about \$10 per square yard for an asphalt cap to \$70 per square yard for a multi-media cap.

2.4 IN SITU TREATMENT

In situ treatment involves treating the contaminated soil in place until remediation levels are met.

2.4.1 Biodegradation

In situ biodegradation involves enhancement of naturally occurring and amended soil-borne microorganisms capable of metabolizing organic contaminants. The wastes are either consumed as an energy source or broken down by enzymes secreted by the microorganisms. Aerobic biodegradation processes take place in the presence of oxygen and result in the formation of carbon dioxide, water, and cell protein. Anaerobic biodegradation processes take place in the absence of oxygen and result in the formation of methane, carbon dioxide, and cell protein. In situ biodegradation decreases the toxicity, mobility, and volume of organic soil contamination through contaminant destruction. Biodegradation may produce secondary organic byproducts that may or may not be toxic. For example, anaerobic biodegradation of trichloroethylene may produce vinyl chloride, which is toxic.

Oxygen (for aerobic biodegradation) and nutrients, including nitrogen and phosphorus, are essential to microbial growth. However, oxygen and/or nitrogen and phosphorus are often deficient in natural soils, resulting in a growth-limiting environment. General limitations of in situ biodegradation usually center around the effective delivery of oxygen, nitrogen (in the form of nitrate or ammonia), and phosphorus to the areas where the contamination exists.

In situ bioremediation is effective for treating a broad spectrum of waste types, but is not recommended for treating metal wastes, which are often toxic to microorganisms. Compounds considered amenable to bioremediation include halogenated aliphatic compounds, nitrated compounds, heterocyclics, simple nonhalogenated aromatics, polynuclear aromatics, and polar nonhalogenated organic compounds. Bioremediation has demonstrated limited effectiveness toward nonpolar halogenated aromatics, PCBs, dioxins, furans, halogenated phenols, cresols, amines, thiols, and other polar aromatics. Bioremediation is ineffective toward halogenated cyclic aliphatics, ethers, esters, and ketones.

In situ biological treatment for PCBs does not trigger TSCA requirements for treatment if the PCB disposal occurred before February 17, 1978. Extensive treatability testing should be conducted prior to applying in situ bioremediation since studies have shown enhanced PCB mobility in soil through transport on particulates as a result of aeration and nutrient addition to the subsurface (EPA, 1990a). This phenomenon should be considered when potential groundwater contamination is a concern.

Implementability concerns include efficient delivery of oxygen (for aerobic biodegradation) and nutrients to microorganisms in areas where contamination exists. Generally, it is desirable for a site to have a highly permeable soil/aquifer composed of a relatively homogeneous matrix so that oxygen and nutrients can be easily and reliably delivered to areas where needed.

Treatability testing should be conducted to determine potential applications and limitations of the technology at a particular site. Of particular importance are the identification of biodegradation byproducts, the time required for cleanup, the level of cleanup attainable, and the cost of cleanup.

Costs associated with in situ biodegradation are very site-specific and can only be determined after treatability testing. In general, in situ biodegradation is a very cost-effective remedial technology at sites where conditions are suitable.

2.4.2 Radio-Frequency Heating

Radio-frequency heating uses electromagnetic energy in the radio-frequency band to heat soil rapidly and uniformly to a temperature range of 150 to 200 °C. The heating is performed by energizing an array of electrodes that are emplaced in boreholes drilled through the soil. The heat encourages volatilization of organic contaminants. Contaminants are then recovered through soil-vapor extraction (see the description of Soil-Vapor Extraction below). This innovative technology has been demonstrated in the field for a site with petroleum hydrocarbon contamination from a jet fuel spill (ITT Research Institute, 1992). Approximately 94 to 99 percent of the aliphatic and aromatic hydrocarbons were recovered during this demonstration.

Laboratory studies have also been conducted for the removal of PCBs from soil (ITT Research Institute, 1992). A sandy soil and clayey soil were each spiked with PCB 1242 to an initial concentration of 1,000 to 1,250 parts per million (ppm). Recovery using radio frequency heating was 48 to 99.7 percent.

This technology reduces contaminant volume through contaminant recovery. Secondary treatment of the recovered contaminants is necessary for permanent reductions in contaminant toxicity and mobility.

2.4.3 Soil Flushing

Soil flushing is an in situ treatment process that uses a flushing system and groundwater extraction wells to recover organic or metal contaminants from soil. Flushing water is sprayed over the contaminated soil to leach contaminants from the soil. The flushing solution carries the contaminants to groundwater. Downgradient groundwater-extraction wells then recover the contaminants. Depending on contaminant properties, acids, bases, or surfactants may be added to the flushing water to aid in contaminant recovery.

Soil flushing is most appropriate for sites with (1) subsurface-soil contamination that extends vertically to groundwater, (2) shallow groundwater that has already been contaminated by leaching from the contaminated soil, (3) permeable soils that are contaminated with only a few specific chemicals, and (4) a homogeneous soil/aquifer system in which subsurface contaminant transport can be predicted. Soil flushing would not be appropriate for the sites at TEAD-N because of the great depth to groundwater at the sites (hundreds of feet). Also, soil contamination at the sites is believed to be largely surficial, and groundwater is not known to be contaminated. Treatment of soil contamination under these conditions is much more practical through excavation or other treatment techniques.

2.4.4 Soil-Vapor Extraction

Soil-vapor extraction (SVE) involves the removal of volatile organics from the soil matrix by mechanically drawing air through the unsaturated layer. As the air is pulled through the soil, the equilibrium that exists among the organic compounds distributed on soil particles, in soil moisture, and in soil gases is disturbed. Soil gas laden with volatilized organic compounds is replaced with fresh air, causing additional contaminant mass to volatilize from soil particles and soil moisture into the soil gas. This process typically includes a series of vertical extraction vents connected by a common manifold to an extraction pump or blower. SVE reduces contaminant volume through recovery of contaminants. Secondary treatment of the recovered contaminants is necessary for permanent reductions in toxicity and mobility of the contaminants.

A determination as to whether SVE may be appropriate for a given site is based on the soil contaminant characteristics. Chemical parameters of interest include the Henry's Law Coefficient (H_c), vapor pressure, octanol-water partition coefficient, and solubility. SVE can effectively extract compounds with H_c values greater than 0.001, including less-volatile hydrocarbons such as gasoline, diesel fuel, kerosene, and heavy naphthas.

An evaluation of soil characteristics is also necessary to determine whether SVE may be appropriate at a given site. Soil parameters of interest include soil permeability, porosity, and moisture. SVE has demonstrated good performance in removing volatile organics from soil with permeabilities ranging between 10^{-4} and 10^{-8} cm/sec. The radius of influence depends upon soil density and soil porosity, but varies usually between 15 to 100 feet. If information on soil parameters is not available, these data may be collected during a treatability test.

Treatability testing is necessary to determine the design and to predict the cost of a SVE system. SVE costs vary depending upon the distribution and concentration of the contaminants, contaminant properties (e.g., Hc, vapor pressure, solubility), and soil properties (e.g., permeability, porosity, moisture content) because these factors determine the number of SVE extraction vents, blowers, and type of air emission controls needed.

Because of hazards associated with accidental detonations, placement of SVE vents may not be practical at sites containing buried ordnance. Otherwise, SVE is a straightforward operation using readily available equipment. The availability of qualified SVE equipment vendors should present no significant problems. SVE costs strongly depend on whether off-gas treatment is required and whether any wastewater is generated at the site. SVE treatment costs are typically \$50 per ton; however, costs can range between \$10 per ton (for a large remediation project with no off-gas treatment and no wastewater generated) and \$150 per ton (for a small remediation project with off-gas treatment and generated wastewater).

2.4.5 Stabilization

In situ stabilization techniques use mechanical mixers to distribute a solidifying agent (e.g., cement) into the soil. Hardening of the solidifying agent binds the soil contaminants into a solid matrix. Adequate mixing and contact of the setting agent with the soil contaminants and proper hardening are necessary for this technology to be effective. Stabilization reduces the mobility, but does not reduce the toxicity or volume of soil contaminants. Stabilization generally results in a soil volume increase. As with the other in-situ treatment methods, the cost of in situ stabilization is site-specific. Stabilization is described in more detail in Section 2.5.8.

2.4.6 Vittrification

In situ soil vittrification involves melting contaminated soil to bind the waste into a glassy, solid matrix that is resistant to leaching. In situ vittrification was originally developed for treatment of radioactive wastes, although it has potential for use with soils contaminated with heavy metals, inorganics, and organic wastes.

In situ vittrification consists of placing electrodes in the soil and constructing trenches filled with a flaked graphite and glass-frit mixture to connect the electrodes in an X pattern. Voltage is then applied to the electrodes, and the graphite/glass-frit mixture is quickly heated to 3,600 °F, which is well above the melting point of soil (2,000 to 2,500 °F). A molten zone expands horizontally and vertically to encompass the volume between the electrodes. As the soil melts, organic wastes are pyrolized and combust when they come in contact with air. High temperatures at the soil surface virtually complete combustion of the organics in the gases. Noncombusted volatiles are collected in an off-gas hood for treatment. Contaminants that do not volatilize remain in the molten soil and become part of the glass and crystalline product after cooling. When the desired vittrification depth is reached, the electrodes are turned off and the molten soils are allowed to cool. Cooling and solidification of the molten mass results in a reduction of the contaminated volume.

In situ vitrification tests have been completed on an engineering-scale (0.5 to 1.0 tons of soil), a pilot-scale (10 tons of soil), and a large-scale (400 to 800 tons of soil). Test results have shown that 99.99 percent of volatile heavy metals are trapped in the vitrified mass or removed by the off-gas system. Although in situ vitrification appears to be a promising technology, a fire occurred in a soil vitrification during a large-scale test at a Superfund site (Hazmat World, August 1991). Following the fire, the sole marketer of the technology suspended large-scale commercial operations. This technology is again available.

2.5 EXCAVATION WITH ON-SITE TREATMENT AND DISPOSAL

2.5.1 Biological Treatment

For soil affected by organic constituents, biological treatment may be an appropriate alternative. Biological treatment techniques include batch reactors for slurried soil, land farming, and composting. Ordinarily, this process requires nutrient supplements of oxygen, nitrogen, and phosphorus. As necessary, microorganisms can be added to the soil. Nutrients and microorganisms may be applied either to a batch reactor of slurried soil or by spraying onto land-farmed or composted soil. For batch treatment, soil is wetted into a pumpable form and supplemented in an above-ground reactor(s) for mixing. Afterward, the soil is spread over a lined surface for the biological reaction to occur. In land farming, nutrients, oxygen, water, and possibly microorganisms are added to soil that has been spread over a lined surface. Oxygen is supplied by ambient air added by routine mixing of the soil, during which the other amendments are added by spraying. The soil is supplemented as needed until proposed treatment standards are met. In composting, a small percentage (< 10 percent) of biodegradable waste is added to a compost of highly biodegradable and firm material (e.g., chopped hay, wood chips, etc.) (EPA, 1988b).

Biological treatment is not effective for removal of inorganic constituents or nonbiodegradable organics. This technology is also ineffective if concentrations of inorganic or organic constituents are sufficiently high to be toxic to the microorganisms. Many chlorinated organic constituents cannot be treated by this technology. This is because the aerobic conditions typically established for both batch-slurry and land-farming applications are not conducive to the anaerobic microorganisms capable of metabolizing chlorinated compounds. Modifications can be made, however, to batch and land-farming techniques in order to establish anaerobic conditions, but commercially available vendors who perform this service are limited.

Composting of soil that is contaminated with explosives such as trinitrotoluene (TNT), cyclonite (RDX), and HMX is an innovative technology that shows potential as an alternative to incineration (USATHAMA and Roy F. Weston, Inc., 1990). Composting of explosives may also be less expensive than incineration (USATHAMA, 1991).

Biological treatment uses contaminant destruction to reduce the toxicity, mobility, and volume of biodegradable organic contaminants. Some considerations for biological treatment of soil include treatability testing, space for spreading of soil, shelter or containment of runoff and/or

leached water, and temperature/weather conditions. Costs for batch reactor and land-farming treatment typically range from \$40 to \$70 per cubic yard of soil treated.

2.5.2 Chemical Extraction

Chemical-extraction processes are used to separate contaminated soils into organic, water, and solid-phase fractions. Chemical extraction uses contaminant recovery to reduce contaminant volume. Secondary treatment of the recovered contaminants is necessary for permanent reductions in contaminant toxicity and mobility. Critical-fluid extraction and the Basic-Extraction Sludge Technology (BEST) process are two types of chemical-extraction technologies.

Critical-fluid extraction technologies use liquified gasses (usually carbon dioxide, propane, and/or butane) to extract organic contaminants from excavated soil. Using a continuous process, contaminated material is fed into an extractor while liquified gas flows countercurrently through the extractor, making nonreactive contact with the material. Clean material is removed from the extractor while the mixture of solvent and organic contaminant passes into a separator, where the solvent is vaporized and recycled. Organic contaminants are drawn off as a concentrate for further treatment or disposal (EPA, March 1990).

As part of the Superfund Innovative Technology Evaluation (SITE) program, a pilot-scale application of critical-fluid extraction was conducted at a Superfund site. Although organic contaminant extraction efficiencies were reportedly high, critical-fluid extraction operations experienced difficulties such as cross-contamination of the extraction system, retention of solids in system hardware, and foaming in receiving tanks (EPA, November 1990). Critical fluid extraction system design and operation has since been improved, resulting in a once-through mode of operation (i.e., no recycling of waste) to achieve required treatment levels and a greater than 99 percent extraction efficiency in full-scale operations (CF Systems, January 1992).

The BEST process uses aliphatic amines to break down organic suspensions and emulsions in sludges and contaminated soils. The BEST process consists of a cold stage followed by a hot stage. In the cold stage, sludges or soils are mixed with the refrigerated extractant to form a mixture at about 40 °F. After an appropriate residence time is completed, the solids in the mixture are separated from the liquid. Precipitated metal oxides, formed because of the alkaline nature of the extractant, are removed with the solids. The liquid is then heated in the hot stage, causing the liquid to separate into two phases: (1) solvent/water phase and (2) solvent/oil/organic phase. These two phases are then recycled back into the treatment process (EPA, 1988b). The produced phases require further treatment prior to disposal.

The BEST process is potentially effective in treating soils containing organic contaminants, including PCBs. Performance can be influenced by the presence of detergents and emulsifiers, system pH, and the reactivity of the organics with the solvent.

The BEST technology is modular, allowing for on-site treatment. The only commercial-scale BEST process unit built (70 tons per day) was designed to treat pumpable oily sludges and

was used at the General Refining Site near Savannah, Georgia. A pilot-scale demonstration is being conducted as part of the SITE program to treat sediments containing PCBs and polynuclear aromatic hydrocarbons (PAHs) at the Grand Calumet River Superfund Site in Gary, Indiana (Resource Conservation Company, May 1992). Reportedly, two full-scale critical-fluid solvent extraction systems are in operation, and a third full-scale unit is proposed for a remediation of an EPA Region VI Superfund site (CF Systems, January 1992).

Unit costs for chemical-extraction systems will depend upon the technology used and the type and volume of waste treated. Approximate critical-fluid solvent extraction unit costs range between \$100 to \$450 per ton of material processed (EPA, August 1990). Unit costs for the BEST process typically range between \$100 per ton for sludge (70 ton per day processed) to \$500 per ton for soil (25 tons per day processed) (Resource Conservation Company, October 1991).

2.5.3 Dechlorination

Chemical dechlorination is a detoxification process that reduces the toxicity, mobility, and volume of soil contamination. Chemical dechlorination uses potassium polyethylene glycolate (KPEG) to dehalogenate certain classes of chlorinated organics, including PCBs, tetrachlorodibenzo-p-dioxin (TCDD), and some herbicides from liquids, soils, and sludges. Chemical dechlorination occurs by way of a nucleophilic-substitution process. In the KPEG process, contaminated materials and reactant are added to a steam-jacketed mixer. Steam (80 pounds per square inch) circulates through the mixer jacket, while the mixer is rotating at 60 revolutions per minute (high speed). The KPEG process can be modified using the alkaline metal polyethylene glycol (APEG) process. In the APEG process, the reaction can be catalyzed using dimethyl sulfoxide (DMSO), which increases the rate of the reaction by increasing the alkalinity of the KPEG. The DMSO also aids in the extraction of the contaminant from the soil. Mixer contents are maintained at 150 °C for 4 hours, after which the steam generator and mixer are shut down and the contents are allowed to cool. After cooling (approximately 8 hours), treated materials are neutralized and discharged.

Principal components for a field-scale KPEG treatment system includes the mixer, liquid reagent loading system, steam generation system, nitrogen system, process cooling system, ventilation system, and a condensate collection system. Soil and debris must be sized in order to screen particles greater than 0.5 inches, which can jam the mixer.

Results of field-scale KPEG demonstrations have shown that PCBs can be reduced from levels in excess of 3,500 ppm by an average of 99.84 percent (99.58 to 99.98 percent). Products of the KPEG process have been shown to be nontoxic, nonmutagenic, and nonbioaccumulative. PCB contaminated soils (greater than 50 ppm) may be disposed after treatment using a method that can achieve a level of performance equivalent to incineration [40 CFR 761.60(e)]. KPEG can achieve performance levels equivalent to incineration; however, treatability studies are required to demonstrate that remedial objectives can be achieved on a consistent basis for the material that is to be treated. Off-site facilities used to treat PCB-contaminated materials must be permitted under TSCA. The KPEG process will

result in substantial reductions of PCB concentration; however, residual levels may still exceed the disposal requirements for hazardous waste landfills.

2.5.4 Detonation

If UXO is present at a site, one of the most viable alternatives would be to explode the ordnance in place. Detonation would be done by military experts who specialize in ordnance disposal. This technology is not applicable to the six sites in this FS, however, because UXO is not present at these sites.

2.5.5 Incineration

Transportable (on-site) incineration reduces the toxicity, mobility, and volume of organic contaminants through contaminant destruction. Transportable incineration technologies primarily used for remedial application include rotary kiln incineration, infrared-thermal treatment, and fluidized-bed incineration. The assessment of each technology must be based upon individual considerations as they pertain to specific applications. Transportable incinerators capable of accepting soils are generally of the rotary kiln type. The rotary kiln is a cylindrical refractory-lined shell that is mounted on a slight incline. Rotation promotes movement of waste through the kiln as well as enhancement of waste mixing. Rotary kilns can incinerate solids, semi-solids, and liquids independently or in combination, and pretreatment requirements are generally less than those for other types of hazardous waste incinerators. Incineration efficiencies are very high when rotary kilns are coupled with a secondary combustion chamber, with combustion temperatures ranging from 1,500 to 3,000 °F and residence times from a few minutes to a few hours. For these reasons, rotary kilns are preferred for the incineration of various hazardous-waste residues.

Incineration of hazardous wastes is one of the most effective ways of detoxifying or destroying organic compounds, including PCBs and chlorinated dioxins. However, incineration is not an effective method of treating all waste materials. Waste materials containing toxic elements such as arsenic, beryllium, nickel, copper, mercury, lead, cadmium, and chromium are not destroyed by combustion, but are concentrated in the ash residue. At operating temperatures between 1,600 and 2,200 °F, some metals such as mercury and lead are volatilized and released into the flue gas. Thermally treated hydrocarbons containing halogens (e.g., fluorine, bromine, and chlorine) form acid gasses that cause corrosive attack of equipment (e.g., refractory brick, scrubber equipment, and stacks) and may require scrubbing to prevent acid gas emissions. Wastes containing phosphorus, cyanide, and alkali metals can also cause damage to incinerator equipment.

TSCA applies to mobile incinerators in the area of PCB treatment and disposal. TSCA requires (1) destruction and removal of PCBs at 99.9999 percent efficiency; (2) continuous monitoring of flow, temperature, and residence time in the secondary combustion chamber; (3) continuous monitoring of oxygen and carbon monoxide; and (4) control of particulate and hydrochloric acid emissions while PCBs are incinerated. A trial burn, demonstrating satisfactory compliance with the above standards, is also required.

Transportable incinerators are currently in use and planned for use at a number of CERCLA sites. Incinerator mobilization, trial burn, and demobilization requirements are such that a significant portion of the time and costs associated with on-site incineration are outside of actual treatment. For example, the trial burn process for PCBs requires approximately 20 to 24 months. For these reasons, the demand for incineration and logistics regarding on-site applications have combined to create a severe shortage of incineration capacity. Consequently, it is not economically feasible to mobilize an on-site incinerator to a site unless there are at least 10,000 cubic yards of material, with exceptions for extremely toxic materials.

The cost for a transportable incineration unit consists of fixed costs (i.e., site preparation, mobilization/demobilization, permitting, trial burn) and variable costs (i.e., labor, utilities, system equipment capital use fees, laboratory analysis). Fixed costs are inherent in applying a mobile system for on-site treatment and exist regardless of the quantity of waste to be processed. Mobilization costs (fixed) will generally run in excess of \$1,000,000, and approximate variable costs will run between \$300 and \$600 per ton.

2.5.6 Physical Separation

Physical-separation processes include screening, classification, flotation, and gravity concentration to separate fine soils from coarser ones. This reduces the volume of waste stream requiring treatment. Since many contaminants may be adsorbed on fine-grained materials, such as clay and organic matter, the coarse-grained portion of the waste stream often may be returned to the environment or treated as nonhazardous waste. Secondary treatment of the fine-grained portion is necessary in order to provide permanent reductions in toxicity and mobility of the contaminants. The most appropriate solids separation technologies for a given site depend upon several factors, including the following:

- Volume of contaminated soils
- Composition of soils, including particle size and percent clays
- Type of excavation equipment used, which determines the feed rate to solids separation equipment
- Site location and surroundings (the available land area and ultimate or present land use may limit the type of system that can be utilized)

2.5.7 Soil Washing

Soil washing is a method of extracting contaminants from excavated soil using a washing solution. Typically, water is added to excavated soil in a washing unit to form a slurry. The addition of surfactants, chelating agents, heat, and/or adjustment of the slurry pH may

improve process efficiency. Soil and contaminant characteristics determine what, if any, agents are added to the washing solution. Treatability testing may be necessary to optimize soil-washing conditions.

The slurry is subjected to intense mixing so that aggregates are broken up into coarse solids (e.g., sand and gravel) and fine particles (e.g., silts and clays). Since many contaminants partition to a fine size fraction of soil (i.e., particle size less than 38 microns), recovery of the cleansed coarse solids results in a significant reduction in the volume of the contaminated soils. Secondary treatment of the recovered fines and washing liquid is necessary to provide permanent reductions in toxicity and mobility of the contaminants.

Soil washing is usually applied to soils that are predominantly sand and gravel. An economic reduction in waste volume is difficult to achieve for soils containing appreciable amounts of silts, clays, and humic material. In general, the fraction of soils finer than 38 microns (400 mesh) should not exceed 20 to 30 percent by weight for soil washing to be effective (BioTrol, October 1991).

Contaminant levels in washed soil are generally 90 to 99 percent lower than in the feed soil; however, removal rates are dependent upon the type of contaminant, initial contaminant levels, and soil matrix. Soil-washing systems can be tailored to remove both organic and inorganic contaminants including metals, petroleum hydrocarbons, polynuclear aromatic hydrocarbons (PAHs), solvents, pentachlorophenol, and PCBs.

The areal and vertical distribution of soil contamination is used to estimate the level of effort and time required to excavate the wastes. Once excavated, soil washing is a straightforward operation that has been conducted at numerous waste sites. The availability of soil-washing vendors should not hinder implementation of this remedial alternative.

Soil-washing system operations are usually continuous using 3 shifts per day, 7 days per week for the duration of the project. The utility requirements of soil-washing systems typically include 500 amps of 460-volt three-phase power and 25 to 100 gallons of makeup water per minute during process water recycle. Approximately 1 acre is needed for soil stockpiles, screening, and treatment for a full-scale system.

Soil-washing is considered a cost-effective alternative for the remediation of large quantities of soil, usually in excess of 10,000 tons. Capital costs for full-scale system (20 tons per hour unit) startup can be expected to range from 3 to 5 million dollars. Unit operating costs typically range from \$40 to \$50 per dry ton of soil, excluding site excavation, debris removal, and residual treatment and/or disposal.

2.5.8 Stabilization

Stabilization is a treatment process designed to improve the handling and physical properties of a waste, generally through solidification of the waste into a monolith. Stabilization technologies have been most effective when treating inorganic wastes and are commonly used to achieve a leachate-based performance standard, such as the Toxicity Characteristic

Leaching Procedure (TCLP). Stabilization can be performed in-situ or on excavated materials. Stabilization reduces contaminant mobility but does not reduce contaminant volume or toxicity. Solidification generally results in a volume increase.

Cement-based stabilization involves the mixing of waste materials with Portland™ cement, usually Type I, and water. Although used primarily as a setting agent, Portland™ cement can chemically immobilize metals, forming relatively insoluble metal hydroxides and carbonates. Flyash, sodium silicate, bentonite, or proprietary additives can be added to cement to improve the strength and chemical resistance of the product (EPA, June 1986). The final product will depend upon the type and amount of reagent added but may vary from a granular, soil-like substance to a cohesive solid.

Pozzolan-based stabilization involves the mixing of waste materials with siliceous or aluminosilicate materials and a setting agent. Common pozzolans include flyash, pumice, lime kiln dust, and blast furnace slag. The primary containment mechanism of wastes treated with pozzolans is physical entrapment of contaminants in the resulting matrix. During pozzolan-stabilization of PCBs, there is some evidence that hydroxides are substituted on the biphenyl ring causing a dechlorination reaction, resulting in a dechlorinated product that is less likely to be as toxic as the parent molecule (EPA, August 1990b). Polyvalent metal ions from the waste solution, or setting agent, act as initiators of silicate precipitation and/or gelation. The solid that is formed varies from a moist, clay-like material to a hard, dry solid similar in appearance to concrete.

Stabilization is a proven and effective technology for treating soil and waste materials containing metals, and has been used at numerous waste sites including Superfund sites. Cement, however, is not compatible with all waste materials. Acidic or acid-producing materials such as sulfides can destroy concrete after setting by reacting with carbonates and hydroxides. Additionally, oil, grease, or large amounts of fine wastes such as silts and clays can interfere with waste bonding and can lower the strength of the final product (EPA, June 1986). Materials such as sodium borate, calcium sulfate, potassium bichromate, and carbohydrates can interfere with the formation of calcium silicate and aluminum hydrates needed to promote pozzolan bonding reactions. For these reasons, thorough treatability testing is recommended whenever stabilization is considered for treating waste.

Detailed characterization of OU sites and wastes during treatability testing would precede implementation of remediation activities to determine the level of effort and time required to excavate the wastes. Once excavated, waste stabilization is a straightforward operation using readily available earthwork equipment. The availability of qualified stabilization vendors should present no significant problems.

Stabilization costs vary depending upon the volume of waste, physical/chemical characteristics of the waste, the amount of stabilizing reagent used, and whether stabilization is performed in situ, on excavated soils, or in drums. Typical unit-stabilization costs range between \$30 per ton for in situ stabilization to \$225 per ton for in-drum stabilization (EPA, 1986).

2.5.9 Thermal Desorption

Thermal-desorption systems are physical-separation processes that remove contaminants from soils by mixing soils in the presence of a stream of heated air or indirectly contacted with a heated fluid to volatilize and remove organic contaminants from excavated soil. Depending upon the technology used, contaminated media are heated to temperatures ranging from 200 to 1,000 °F. Air, combustion gas, or inert gas is used as the transfer medium for the vaporized contaminants. Thermal desorption is not incineration since destruction of organic contaminants is not the desired result, although the higher temperatures of some systems will result in localized oxidation and/or pyrolysis. Off-gases may be burned in an afterburner, condensed to reduce the volume to be disposed, or captured by carbon adsorption beds.

Thermal desorption has been proven effective in bench-scale through full-scale applications for treating contaminated soils containing volatile organic compounds (VOCs), semi-volatile organic compounds (semi-VOCs), and PCBs. Thermal desorption is not effective in separating inorganics from soil; however, volatile metals may be removed by higher temperature thermal-desorption systems.

Soils suitable for thermal desorption must be appropriately sized (soil particles less than 1 to 3 inches in diameter) and preferably of low moisture content since soils with relatively high moisture content require longer residence times to drive off the excess moisture prior to desorption and volatilization of organic compounds.

The areal and vertical distribution of soil contamination is used to estimate the level of effort and time required to excavate the wastes. Once excavated, thermal desorption is a straightforward operation.

Most thermal-desorption units are mobile and are transported on flat-bed trailers. Space requirements for on-site thermal desorption equipment is typically 50 feet by 150 feet, exclusive of space requirements for material handling and decontamination. A source of readily available water and 440-volt, three-phase electrical service is also required. Thermal desorption technologies are currently in use and planned for use at a number of CERCLA sites. The demand for thermal-desorption technologies and logistics regarding on-site applications have combined to create a severe shortage of thermal-desorption capacity. It is, therefore, not economically feasible to mobilize a thermal-desorption unit unless there are at least 10,000 cubic yards of material.

Mobilization and demobilization costs for a full-scale thermal desorption unit are approximately \$1,000,000 exclusive of any treatability testing and engineering design. Unit processing costs vary depending upon the technology used, but can be expected to range between \$300 and \$800 per ton.

2.5.10 Volatilization/Venting

Soil containing VOCs may be spread over a lined surface to allow VOCs in the solid or liquid phase to transfer to the gaseous state. In the gaseous form, the VOCs are removed from the

soil as they diffuse to the soil surface and are advected by wind or vacuum currents. This volatilization process may be enhanced by routinely tilling the soil to expose VOCs to the surface or by inducing advection within the soil by introducing air and/or creating a vacuum. The vapors may then be collected and treated, depending on regulatory requirements for air emissions. Costs for this technology range from \$20 to \$50 per cubic yard. This treatment technology is not applicable for removal of nonvolatile organic or inorganic constituents.

2.6 EXCAVATION WITH OFF-SITE TREATMENT/DISPOSAL

This response action would involve the removal of contaminated soils exceeding remediation levels. The soils removed would be sent to an off-site facility for treatment and disposal. Clean backfill would be required to replace removed soils.

2.6.1 Off-Site Incineration

Commercial incineration (off site) is used to detoxify a waste material by destroying the organic portion of the waste. Commercial incinerators capable of accepting soils are generally of the rotary kiln type. The rotary kiln is a cylindrical refractory-lined shell that is mounted on a slight incline. Rotation promotes movement of waste through the kiln as well as enhancement of waste mixing. Rotary kilns can incinerate solids, semi-solids, and liquids independently or in combination, and pretreatment requirements are generally less than those for other types of hazardous-waste incinerators. Incineration efficiencies are very high when rotary kilns are coupled with a secondary combustion chamber, with combustion temperatures ranging from 1,500 to 3,000 °F and residence times from a few minutes to a few hours. For these reasons, rotary kilns are the preferred method for treating various hazardous-waste residues.

Incineration of hazardous wastes is one of the most effective ways of detoxifying or destroying organic compounds, including PCBs and chlorinated dioxins. However, incineration is not an effective method of treating all waste materials. Toxic elements such as arsenic, beryllium, nickel, copper, mercury, lead, cadmium, and chromium contained in waste materials are not destroyed by combustion, but are concentrated in the ash residue. At operating temperatures between 1,600 and 2,200 °F, some metals such as mercury and lead are volatilized and released into the flue gas. Thermally treated hydrocarbons containing halogens (e.g., fluorine, bromine, and chlorine) form acid gasses that cause corrosive attack of equipment (e.g., refractory brick, scrubber equipment, and stacks) and may require scrubbing to prevent acid gas emissions. Wastes containing phosphorus, cyanide, and alkali metals can also cause damage to incinerator equipment.

Current constraints regarding the application of commercial rotary kilns include available capacity and the type of wastes that are acceptable. Soils are generally not preferred because of their high ash content and low British Thermal Unit (BTU) value. PCB-contaminated soils may be disposed of by incineration at a TSCA-permitted facility. Incineration of PCB contaminated materials must achieve 99.9999 percent destruction and removal efficiency.

Off-site incineration is cost effective when applied to materials with high contaminant concentrations and relatively low volumes. Current unit incineration costs at a RCRA-approved facility run between \$0.45 and \$2.10 per pound, excluding transportation and all preprocessing.

2.6.2 Off-Site Landfilling

Off-site landfilling of wastes involves the excavation, transport, and disposal of wastes in an approved landfill. Hazardous wastes (RCRA listed and characteristic wastes) must be disposed of in an approved RCRA hazardous-waste landfill and are subject to land disposal restrictions (LDRs). PCB-contaminated soils (greater than 50 ppm) can be disposed of in a TSCA-approved landfill. Soils contaminated by low-level radioactive materials can be sent to an off-site NRC-licensed disposal facility. Other off-site disposal alternatives for low-level radioactive waste include licensed underground mines or ocean disposal. Nonhazardous wastes may be disposed of without treatment in an industrial or municipal landfill subject to acceptance of the waste by the landfill and State Regulatory Authority.

Hazardous wastes may require pretreatment at a RCRA-licensed treatment facility to meet the LDRs for disposal at a RCRA landfill. Low-level radioactive wastes may also require pretreatment to meet NRC disposal requirements. The need for pretreatment depends upon the constituents, concentrations, compatibilities, and physical/chemical properties of the waste. Pretreatment may include neutralization (acids/bases), stabilization (metals), incineration (halogenated organic compounds [HOCs] greater than 1,000 ppm), or flash point reduction/detonation (explosives). Excavation and removal of waste from a site can eliminate the contamination at a site and the need for long-term monitoring. Off-site landfilling is a potentially effective remedial alternative for the disposal of all types of wastes dependent upon required pretreatment and landfill acceptance of the wastes. Permanent reductions in contaminant toxicity, mobility, or volume are dependent upon the pretreatment and disposal practices of the receiving facility.

The biggest drawbacks to excavation and removal of wastes for off-site landfilling are the potential hazards associated with worker exposure during excavation and handling of the wastes, public exposure during transport of the wastes, and long-term liability for the wastes at the disposal site. Accidental detonation of explosives or mixing of incompatible materials would be of particular concern at sites suspected of containing buried ordnance or wastes of unknown origin.

The areal and vertical extent of soil contamination is used to estimate the level of effort and time required to excavate and dispose of the wastes. Once excavated and processed, waste transport and off-site disposal is a straightforward operation that has been conducted at numerous CERCLA sites. RCRA manifest requirements must be complied with for all hazardous wastes shipped off-site (40 CFR Parts 262 and 263). The availability of landfilling facilities should not hinder implementation of this remedial alternative.

The costs associated with off-site landfilling of OU wastes will depend upon the type of waste involved (i.e., hazardous versus nonhazardous), the level of effort required to excavate the

wastes, the level of effort required to pretreat the waste, the distance to the receiving disposal facility, the mode of transportation, and prevailing transportation and landfilling fees. The approximate unit cost for landfilling nonhazardous wastes ranges from \$25 per ton to \$50 per ton and, for hazardous wastes, from \$100 per ton (without treatment) to \$250 per ton (with treatment).

3.0 OPERABLE UNIT 5

OU 5 is located in the maintenance area of TEAD-N and consists of two sites: the Former Transformer Storage Area (Site 17) and the PCB Storage Building 659 (Site 33) (Figure 3-1). Site 17 was formerly used for the storage and handling of transformers. Site 33 is currently used for the storage of transformers and is operated under a TSCA permit. Potential contaminants at these sites are PCBs.

3.1 FORMER TRANSFORMER STORAGE AREA (SITE 17)

3.1.1 Site Description

The Former Transformer Storage Area (Site 17) refers to Open Storage Lot No. 675B. The lot is unpaved, but graveled, and covers an area of approximately 5 acres (350 by 600 feet). A drainage ditch, which parallels the adjacent road, is present along the northern edge of the lot. Lot 675B is currently used for the storage of vehicle-related equipment.

One of the responsibilities of TEAD-N has been the receiving, storage, maintenance, and shipment of oil-containing electrical transformers and capacitors. Prior to 1979, thousands of transformers and capacitors were stored at Site 17. Many of these transformers contained PCB-contaminated oil. In 1979, all transformers were removed from the lot and either properly disposed of or transferred to Building 659 (Site 33) for storage. Building 659 has continued to operate as the storage facility for transformers since 1979.

3.1.2 Nature and Extent of Contamination

Following removal of the transformers in 1979, TEAD Facilities Engineering Division reportedly collected surface-soil samples (0 to 3 inches) at Site 17. TEAD personnel verbally reported that the sampling results indicated that the soils contained less than 50 milligrams per kilogram (mg/kg) total PCBs (EA, 1988). In February 1987, EA conducted a follow-up sampling of the site to confirm the reported TEAD results because no permanent record of these results could be obtained. Samples were collected from 30 grid point locations (Figure 3-2) at 0 to 6 inches in depth and were composited to form 6 samples (N-PCB-CST1 through N-PCB-CST6). These six samples were analyzed for the PCB Aroclors 1016, 1221, 1232, 1242, 1248, 1254, and 1260 (EA, 1988). Analytical results from the EA sampling event showed that two PCB Aroclors were detected in the samples. Aroclor 1254 was detected in one soil sample at 0.019 mg/kg. (Although Aroclor 1254 was detected at 0.019 mg/kg, this value is below the certified reporting limit (CRL) of 0.05 mg/kg, which was established subsequent to the February 1987 sampling conducted by EA.) Aroclor 1260 was detected in two samples at concentrations of 0.100 and 0.108 mg/kg, respectively.

(Table 3-1). Because the soil concentrations used for risk analyses are based upon the composite samples, a conservative approach was taken. It was assumed that all of the PCBs detected in the composite originated in one of the five individual samples, so the composite value was multiplied by five to obtain the risk calculation concentration of 0.5 mg/kg PCB 1260. Based on this information, the contaminant of concern at this site is PCB 1260.

Table 3-1. Analytical Results for Composite Soil Samples Collected at the Former Transformer Storage Area (Site 17), February 23, 1987

Parameter	CST1 (mg/kg)	CST2 (mg/kg)	CST3 (mg/kg)	CST4 (mg/kg)	CST5 (mg/kg)	CST6 (mg/kg)
Aroclor 1016	<0.05	<0.05	<0.05	<0.05	<0.05	<0.05
Aroclor 1254	ND	ND	0.0191	ND	ND	ND
Aroclor 1260	<0.07	<0.07	<0.07	<0.07	0.108	0.10

Note.—ND indicates a compound not assigned a certified reporting limit (CRL) and not detected above the analytical detection limit. The parameters listed were determined according to methods not certified by USAEC.

Source: EA, 1988

3.1.3 Contaminant Fate and Transport

The chemical and environmental stability of PCBs, coupled with their strong adherence to soils, results in relatively long half-lives especially for the more chlorinated isomers. Although PCBs are highly persistent compounds exhibiting generally low volatilization rates, photolysis and volatilization of PCBs are major removal processes over time. In addition, PCBs may enter the atmosphere through adsorption to airborne particulates with removal occurring through wet and dry deposition. The tendency of PCBs to adsorb to particulates increases as the degree of chlorination increases.

Although PCBs are not appreciably taken up by plants, they do bioconcentrate in tissue because of their stability, high lipid solubility and/or binding, and low water solubility. In addition to the low bioavailability of PCBs in soils, the current physical nature of Site 17 (graveled storage lot) minimizes any likelihood of possible PCB bioaccumulation. During site visits in November 1992 and June 1993, no vegetation or wildlife were observed at this site except for a few weeds located in one corner of the lot.

Leaching of PCBs to the groundwater at Site 17 is highly unlikely because of the depth to groundwater at the site (approximately 280 feet), the low concentrations of PCBs detected in the soil, and the relative immobility of PCBs in soils. In addition, PCB soil cleanup levels based on direct contact assumptions will generally provide sufficient protection of groundwater (EPA, August 1990b).

3.1.4 Summary of the Baseline Risk Assessment

The purpose of the Baseline Risk Assessment (BRA) is to evaluate potential human health risks associated with the no-action alternative. The initial task of the assessment involves identification of chemicals present at the site that pose a potential risk to human health based on their prevalence and concentration in the environment and inherent toxicity. After potential contaminants of concern are identified, a toxicity assessment is conducted to estimate the relationship between the extent of exposure to a contaminant and the increased likelihood and/or severity of adverse effects. Then, an exposure assessment is performed to evaluate the pathways by which humans could potentially contact contaminants. The final task consists of determining the magnitude and probability of current and future human health risks associated with the contaminants of concern. This section summarizes the results of the information on the BRA methodology and results.

3.1.4.1 *Human Health Risk Assessment*

As more fully discussed in the RI Report for TEAD-N (Rust E&I, 1994), the most likely exposure pathways for PCBs at Site 17 are via dermal contact, incidental soil ingestion, and inhalation of fugitive dust. However, fugitive dust emissions from Site 17 are minimal because of the coarse nature of the sand and gravel covering the lot. The risk assessment evaluates scenarios for both present land use and future land use conditions. Since there is no construction planned for the Site 17 area, the construction worker scenario can be considered a future case. Current base closure plans envision that the TEAD-N Maintenance Area, in which Site 17 is located, will be utilized for industrial purposes by private firms or other government entities. However, because of uncertainties over the future use of TEAD-N property, possible future on-site residential use was also evaluated for Site 17.

Under the current land use condition, human receptors include the on-site worker, installation resident, installation school student/employee, and off-site resident from the nearby cities of Tooele, Stockton, and Grantsville. The on-site worker and possible future construction worker are potentially exposed through incidental ingestion of soil, dermal contact, and inhalation of fugitive dust. For the remaining current land use receptors, inhalation of fugitive dust is considered the only complete, potential exposure pathway. Site 17 is part of a large industrial complex at TEAD-N and, as such, is not currently available for locally grazed cattle or homegrown produce; therefore, these pathways are not considered complete for the current land use condition but are for the future residential scenario.

For the complete exposure pathways discussed above, two exposure cases are analyzed as part of the BRA. The central tendency risk description presented in Table 3-2 is the arithmetic mean risk and is derived by using average exposure factors but using maximum concentrations back calculated from the highest composite sample concentration (N-PCB-CST5) for each pathway/site considered. The reasonable maximum exposure (RME) description presented in Table 3-3 is the high-end risk. The RME is estimated by combining upper bound values for exposure parameters and the concentrations back calculated from the highest composite sample concentration, N-PCB-CST5, so that the result represents an

Table 3-2. Summary of Human Health Risk Assessment Results Using Average Exposure Levels for Site 17

Analyte	On-Site Worker ^(a)		Construction Worker ^(b)		Installation School ^(c)		Installation Resident ^(d)		Off-Site Resident ^(e) Tooele		Off-Site Resident ^(e) Stockton		Off-Site Resident ^(e) Grantsville		Future On-Site ^(f) Resident	
	RF ^g	HI ^h	RF	HI	RF	HI	RF	HI	RF	HI	RF	HI	RF	HI	RF	HI
<u>Ingestion</u>																
PCB 1260	2.69E-07	3.49E-03	2.69E-08	3.49E-03											9.67E-07	5.06E-02
<u>Inhalation</u>																
PCB 1260	8.64E-11	1.13E-06	8.64E-12	1.13E-06	9.68E-12	6.30E-07	2.59E-11	1.69E-06	4.70E-13	6.80E-09	7.99E-13	1.16E-08	3.98E-12	5.76E-08	1.16E-10	1.69E-06
<u>Dermal</u>																
PCB 1260	1.14E-07	1.50E-03	1.14E-08	1.50E-03											9.62E-08	1.41E-03
<u>Beef Consumption</u>																
PCB 1260															1.16E-06	1.67E-02
<u>Vegetable Consumption</u>																
PCB 1260															3.39E-07	4.89E-03
<u>Fruit Consumption</u>																
PCB 1260															1.90E-07	2.74E-03
Site Total	3.83E-07	5.00E-03	3.83E-08	5.00E-03	9.68E-12	6.30E-07	2.59E-11	1.69E-06	4.70E-13	6.80E-09	7.99E-13	1.16E-08	3.98E-12	5.76E-08	2.75E-06	7.63E-02

^aOn-Site Worker is assumed to work at Site 17 10 hours per day 250 days per year for 10 years.

^bConstruction Worker is assumed to work at Site 17 10 hours per day for 250 days.

^cInstallation School Students/Employees are assumed to be at the school site 7 hours per day 200 days per year for 2 years.

^dInstallation Resident is assumed to live on TEAD-N for 2 years.

^eOff-Site Residents are assumed to live in the TEAD-N vicinity for 2 years.

^fFuture On-Site Residents are assumed to live on Site 17 land for 9 years.

^gRisk factor

^hHazard index.

Table 3-3. Summary of Human Health Risk Assessment Results Using Reasonable Maximum Exposure Levels for Site 17

Analyte	On-Site Worker ^(a)		Construction Worker ^(b)		Installation School ^(c)		Installation Resident ^(d)		Off-Site Resident ^(e) Tooele		Off-Site Resident ^(e) Stockton		Off-Site Resident ^(e) Grantsville		Future On-Site ^(f) Resident	
	RF ^(g)	HI ^(h)	RF	HI	RF	HI	RF	HI	RF	HI	RF	HI	RF	HI	RF	HI
<u>Ingestion</u>																
PCB 1260	1.35E-06	6.99E-03	2.58E-07	3.35E-02											6.03E-06	1.01E-01
<u>Inhalation</u>																
PCB 1260	2.16E-10	1.13E-06	1.30E-11	1.69E-06	1.94E-11	6.30E-07	3.06E-10	1.36E-05	3.93E-12	5.48E-08	6.71E-12	9.35E-08	3.33E-11	4.64E-07	9.75E-10	1.36E-05
<u>Dermal</u>																
PCB 1260	1.43E-06	7.51E-03	5.71E-08	7.51E-03											3.01E-06	3.45E-02
<u>Beef Consumption</u>																
PCB 1260															1.14E-05	1.61E-01
<u>Vegetable Consumption</u>																
PCB 1260															3.13E-06	4.44E-02
<u>Fruit Consumption</u>																
PCB 1260															1.65E-06	2.33E-02
Site Total	2.77E-06	1.45E-02	3.15E-07	4.11E-02	1.94E-11	6.30E-07	3.06E-10	1.36E-05	3.93E-12	5.48E-08	6.71E-12	9.35E-08	3.33E-11	4.64E-07	2.52E-05	3.64E-01

^(a)On-Site Worker is assumed to work at Site 17 10 hours per day 250 days per year for 25 years.

^(b)Construction Worker is assumed to work at Site 17 10 hours per day for 250 days.

^(c)Installation School Students/Employees are assumed to be at the school site 7 hours per day 200 days per year for 4 years.

^(d)Installation Resident is assumed to live on TEAD-N for 2 years as a child and 7 years as an adult.

^(e)Off-Site Residents are assumed to live in the TEAD-N vicinity for 30 years.

^(f)Future On-Site Residents are assumed to live on Site 17 land for 30 years.

^(g)Risk factor.

^(h)Hazard index.

exposure scenario that is both protective and reasonable (EPA, 1991a). For Site 17, a conservative value of 0.5 mg/kg PCB was used as the soil concentration for both the average and RME calculations. Both Tables 3-2 and 3-3 include carcinogenic and noncarcinogenic risk estimates for all complete pathways.

At Site 17, all of the chronic, noncarcinogenic risk estimates meet the EPA goal for a residual hazard index of 1 or less. In addition, all of the carcinogenic risks fall below or within the EPA target range for residual risk of $1\text{E-}4$ to $1\text{E-}6$.

3.1.4.2 Ecological Risk Assessment

The ecological risk assessment for Site 17 was qualitative and did not include tissue sampling or bioassays of the vegetation and wildlife. Site 17 is an open storage lot in an industrial area of TEAD-N with gravel covering most of the site. The most likely wildlife inhabitants are small mammals and birds. There is no indication that this area is a critical habitat for any endangered or threatened species.

The contaminants of concern at Site 17 are PCBs. These compounds are toxic and bioaccumulate to varying degrees, depending on the pathways. Very little is known about their behavior in a terrestrial environment, their lethal and chronic affects, or their movement up a food chain. This is mainly due to the interspecies differences in sensitivity to these compounds that exist, even between species of biota that are related taxonomically. The potential exposure pathways investigated included the uptake of contaminants by vegetation, ingestion of the plants by small mammals or birds, and their consequent ingestion off-site by raptors. The bioaccumulation model that was used in the risk assessment (proposed by Thomas, 1981; modified by Fordham, 1991) used reproductive failure at the second and third order consumer levels as benchmarks to obtain a PCB soil concentration that represented the lowest level at which reproductive failure would occur due to this particular group of contaminants. Using conservative maximum acceptable tissue levels and biomagnification factors, the lowest concentration of PCBs in the soil that would cause a reproductive failure was above the highest detected level of PCB contamination (see Section 5.1.7.2.4 of the *Final Remedial Investigation Report*, February 1994).

Because the PCB concentrations in the soil were below the reproductive failure benchmark value and all future land use scenarios used in the risk assessment included human activity, the overall risk to ecological receptors on this site, and to the TEAD-N ecosystems as a whole, appears to be minimal. Alterations to the trophic structure and ecological processes at Site 17 or to the TEAD-N facility due to existing contaminants at Site 17 are unlikely.

3.1.5 Remedial-Action Objectives for Soils

The EPA's *Guidance on Remedial Actions for Superfund Sites with PCB Contamination* (EPA August, 1990b) recommends that remedial action be considered when PCB levels exceed 1 ppm (1 mg/kg) for residential land use and 10 to 25 ppm for industrial land use. Available data for Site 17 indicate that soil contamination is below the most stringent of these levels.

Furthermore, the available data for Site 17 indicate that the existing site soils qualify as clean soil (having less than 1 mg/kg PCBs) under TSCA clean-up requirements, although clean soil has not been intentionally placed in the site. Therefore, the following are the remedial-action objectives for Site 17: (1) prevent human and environmental (i.e., fauna and flora) exposure to soil contamination that is present at concentrations above risk-based remediation levels and (2) prevent migration of soil contaminants that are present at concentrations above the risk-based remediation levels to off-site receptors or to surface water and groundwater. The Baseline Risk Assessment for Site 17 indicates that the current condition of the site meets the remedial-action objectives.

3.1.6 General Response Actions for Soils

Although available data indicate that the current condition of the site meets the remediation goals and, therefore, none of the soil needs remediation, the FS process indicates that remedial technologies be identified. The following are the general response actions that are available for Site 17 soil:

- No action
- Institutional controls
- Containment
- In-situ treatment
- Excavation with on-site treatment and disposal
- Excavation with off-site treatment and/or disposal

3.1.7 Identification and Screening of Remedial Technologies for Soils

A variety of remedial technologies are available for the soils at Site 17. Table 3-4 identifies these technologies and screens them according to effectiveness, implementability, and cost. The applicability of each technology depends on factors such as the remediation goals, whether the technology is suitable for PCBs in soil at low concentrations (i.e., <1 mg/kg [ppm] PCBs), and site characteristics. For this site, available data indicate that the current condition of the site meets the remediation goals.

As a result of the screening in Table 3-4, the following technologies have been retained for further consideration during the development of remedial alternatives for soils at Site 17:

- No Action
- Institutional Controls
 - Deed Restrictions
 - Fences

Table 3-4. Technology Screening for Soils at Site 17

Technology	Effectiveness	Implementability	Cost	Screening Results
No Action	Effective because contamination levels are in compliance with ARARs ^(b) and do not pose an excessive human health or environmental risk.	NA ^(a)	No cost.	Consider. Required for consideration by the NCP.
Institutional Controls				
Deed Restrictions	As long as Site 17 is Army property, deed restrictions are not necessary to control the use of the land. Does not reduce contamination.	Readily implementable. ^(c)	Negligible cost.	Consider. Will provide for future public use.
Fences	Long-term enforcement necessary to restrict access to the site. Does not reduce contamination.	Readily implementable.	Low cost. \$25/LF. ^(d)	Consider.
Containment				
Surface Runoff Controls	Does not reduce contamination or prevent exposure of humans, fauna, and flora. Reduces potential for contaminant migration through erosion and leaching. Long-term maintenance and institutional controls necessary.	Readily implementable.	Low cost. Less than or comparable to capping.	Eliminate. Surface-water runoff is not a concern for this site.
Capping	Does not reduce contamination. Prevents exposure of humans, fauna, and flora. Prevents erosion and infiltration of water. Long-term maintenance and institutional controls necessary.	Readily implementable.	Low cost. \$10 to \$70/SY. ^(e)	Consider.
In-situ Treatment				
Biodegradation	Provides destruction of biodegradable organic contaminants. PCB concentrations are too low to establish an effective microbial population.	NA	NA	Eliminate. PCB concentrations are too low for the process to be effective.

Table 3-4. Technology Screening for Soils at Site 17 (continued)

Technology	Effectiveness	Implementability	Cost	Screening Results
Radio Frequency Heating	Process extracts contaminants through enhanced volatilization. Laboratory research is limited to soil with much higher PCB concentrations (> 1000 mg/kg). The driving force for volatilization is very low when contaminant levels are very small (< 1 mg/kg at Site 17).	Process is at the laboratory research and field demonstration stages of development.	Moderate to high cost because of energy use.	Eliminate. PCB concentrations are too low at this site for this process to be effective.
Soil Vapor Extraction	Process extracts volatile organic contaminants from soil. PCBs are not volatile and cannot be extracted using Soil Vapor Extraction.	NA	NA	Eliminate. Not appropriate for PCBs.
Stabilization	Creates a solid monolith that is resistant to leaching. Does not reduce contaminant toxicity or volume. Stabilization can be used for PCBs if concentrations are low, generally less than 20% by weight.	Readily implementable.	Low cost. \$30 + /ton	Consider.
Vitrification	Creates a solid, glassy monolith that is highly resistant to leaching. Reduces contaminant volume but does not reduce toxicity.	Not practical to implement because PCB concentrations are so low (< 1 mg/kg PCBs). Only one vendor is available.	High cost due to high energy consumption.	Eliminate. PCB concentrations are too low for practical application.
Excavation and On-Site Treatment and Disposal				
Biological Treatment	Provides destruction of biodegradable organic contaminants. PCB concentrations are too low for effective treatment (< 1 mg/kg PCBs).	NA	NA	Eliminate. PCB concentrations are too low for effective treatment.
Chemical Extraction	Process extracts organic contaminants. PCB concentrations at Site 17 are too low for this process to be effective.	Process is still largely at the pilot scale and demonstration stages of development. Few treatment units are available.	High cost. \$100 to \$500/ton.	Eliminate. PCB concentrations are too low for effective treatment.

Table 3-4. Technology Screening for Soils at Site 17 (continued)

Technology	Effectiveness	Implementability	Cost	Screening Results
Dechlorination	Process extracts and detoxifies chlorinated aromatic organics, including PCBs. PCB concentrations at this site are too low for this process to be effective.	For treatment of soils, process is still largely at the pilot scale and demonstration stages of development.	Cost data are not available.	Eliminate. PCB concentrations are too low for effective treatment.
Incineration	Provides thermal destruction of organic contaminants.	Incineration of PCBs requires stringent testing and trial burns. A shortage of incinerator availability currently exists.	High cost. \$300 to \$600/ton.	Eliminate. Not feasible because of shortage of incinerator availability. Not practical because of very low PCB concentrations (< 1 mg/kg PCBs).
Physical Separation	Reduces contaminant volume by separating out the fine-grained materials (assuming contaminants are adsorbed to silts and clays). PCB concentrations are too low for effective treatment (< 1 mg/kg PCBs).	Readily implementable.	Low to moderate cost. Less than or comparable to soil washing.	Eliminate. PCB concentrations are too low for effective treatment.
Soil Washing	Reduces contaminant volume by separating out the fine-grained materials (assuming contaminants are adsorbed to silts and clays). Generates wastewater that may require treatment. PCB concentrations are too low for effective treatment (< 1 mg/kg PCBs).	Readily implementable.	Moderate cost. \$40 to \$50/ton.	Eliminate. PCB concentrations are too low for effective treatment.
Stabilization	Creates a solid monolith that is resistant to leaching. Does not reduce contaminant toxicity or volume. Stabilization can be used for PCBs if concentrations are low, generally less than 20% by weight.	Readily implementable.	Low to high cost. \$30 to \$250/ton.	Consider.

Table 3-4. Technology Screening for Soils at Site 17 (continued)

Technology	Effectiveness	Implementability	Cost	Screening Results
Thermal Desorption	Extracts organic contaminants through enhanced volatilization. Secondary treatment is necessary to reduce toxicity and mobility of extracted contaminants.	Not feasible for less than 10,000 CY ⁶ of soil because of shortage in thermal desorption availability.	High cost. \$300 to \$800/ton.	Eliminate. Not feasible because of shortage of incinerator availability. Not practical because of very low PCB concentrations (less than 1 mg/kg at Site 17).
Volatilization	Not appropriate for this site because PCBs are not volatile.	NA	NA	Eliminate.
Excavation and Off-Site Treatment and/or Disposal				
Incineration	Process provides destruction of organic contaminants.	Less practical for soils with less than 50 mg/kg PCBs.	High cost. \$900 to \$4200/ton.	Consider.
Landfill	Removes contaminated soil from the site and eliminates the need for long-term maintenance. Safe excavation and transport are short-term concerns. Long-term effectiveness depends on pretreatment and disposal practices at the receiving facility.	Readily implementable.	Moderate to high cost. \$100 to \$250/ton.	Consider.

^aNA = not applicable.

^bARARs = Applicable or Relevant and Appropriate Requirements.

^cReadily implementable technologies are those for which services or vendors are available.

^dLF = linear foot.

^eSY = square yard.

^fCY = cubic yards.

- Containment
 - Capping
- In-Situ Treatment
 - Stabilization
- Excavation Followed by On-Site Treatment and Disposal
 - Stabilization
- Excavation Followed by Off-Site Treatment and Disposal
 - Landfill Disposal
 - Incineration

3.1.8 Development of Remedial Alternatives for Soils

Available data indicate that the soils at the site:

- Contain insufficient PCBs to require remedial action per EPA guidance (EPA, 1990b)
 - For residential land use, the PCB action level is 1 ppm (mg/kg); for industrial land use, the PCB action level ranges from 10 ppm to 25 ppm.
- Qualify as clean under TSCA
 - Existing soil qualifies as clean soil (having less than 1 mg/kg PCBs) under TSCA.
- Contain insufficient PCBs to create a human health or environmental risk exceeding EPA guidelines
 - Carcinogenic risk within or below $1E-4$ to $1E-6$.
 - Noncarcinogenic risk hazard indices all below 1.

ARARs have been screened from the documents in Appendix A and Table 1-1. Table 3-5 summarizes ARAR choices for Site 17. These are analyzed further in Section 3.1.9.

Six remedial alternatives are being considered for this site:

Alternative 1: No Action. Site soil would remain in place.

Alternative 2: Institutional Controls. This alternative does not involve active remediation; site soils would be left in place. However, this alternative would limit the potential for human and fauna exposure to site contaminants by placing controls on access to the site. These controls would include fences or other barriers, warning signs, and regular surveillance. Deed restrictions would be developed for future protection in the event the property were released to the public.

Table 3-5. Compliance of Alternatives with ARARs for Site 17

Site Number	Alternative 1: No Action		Alternative 2: Institutional Controls		Alternative 3: Soil Cover		Alternative 4: Stabilization		Alternative 5: TSCA Approved Landfill Disposal		Alternative 6: Incineration	
	Meets Sids.	Does Not Meet Sids.	Meets Sids.	Does Not Meet Sids.	Meets Sids.	Does Not Meet Sids.	Meets Sids.	Does Not Meet Sids.	Meets Sids.	Does Not Meet Sids.	Meets Sids.	Does Not Meet Sids.
TSCA-Soils	X		X		X		X		X		X	
EPA PCB Guidance-Soils	X*		X*		X*		X*		X*		X*	
OSHA	NA		X		X		X		X		X	
Utah Air Conservation Act	NA		NA		X**		X**		X**		X**	
Utah Solid & Hazardous Waste Act	NA		NA		NA		NA		X		X	
Utah Solid Waste Mgmt. Act	NA		NA		NA		NA		X		X	
Safe Drinking Water Act (MCLs)	X		X		X		X		X		X	
40 CFR Part 268 Landfill Disposal	NA		NA		NA		NA		X		X	
Utah Groundwater Protection Rule	X		X		X		X		X		X	
Utah Safe Drinking Water Act (MCLs)	X		X		X		X		X		X	
Hazardous Materials Transport Act	NA		NA		NA		NA		X		X	

*=to be considered (TBC)

**=action-specific, would apply during cleanup

NA =not applicable

Alternative 3: Soil Cover. This alternative involves placing a 10-inch-thick clean soil layer over the site, covered by 2 inches of pit-run gravel. The soil layer is assumed to come from on-site. It would be analyzed to verify the absence of PCBs. This alternative does not involve active remediation; site soils would be left in place beneath the cover. However, this alternative would reduce the potential for current human and fauna exposure to site contaminants by placing a soil cover over the site.

Alternative 4: Stabilization. This alternative involves mixing the contaminated soil with a solidifying agent such as cement. Hardening of the solidifying agent binds and reduces the mobility of the soil contaminants. Stabilization can either be done in-situ or in an external mixing vessel. There would be an overall volume increase. The soils would be left in place, but with the contaminant relatively immobilized.

Alternative 5: Landfill Disposal. This alternative involves excavation of contaminated soil and hauling to an approved TSCA disposal site. Clean soil from the facility would be used to backfill the excavation. For Site 17, a volume of 13,000 cubic yards (200 feet x 350 feet x 5 feet deep) was chosen for remediation estimate purposes.

Alternative 6: Incineration. This alternative involves excavation of 13,000 cubic yards of potentially contaminated soil, hauling to a TSCA-approved site, and incineration of the PCBs. Clean soil from TEAD-N would be used to backfill the excavation.

3.1.9 Detailed Analysis of Alternatives for Soils

3.1.9.1 Alternative 1: No Action

Overall protection of human health and the environment. This alternative meets the remedial-action objectives.

Compliance with ARARs. Soils at the site meet the To Be Considered (TBC) EPA guidance (EPA/540/G-90-007) for clean soil of less than 1 mg/kg PCBs. This alternative also meets TSCA standard (40 CFR761.125(c)(4)(v)) of 1 mg/kg PCBs maximum to be classified as clean soil for replacement purposes.

Long-term effectiveness and permanence. The Baseline Risk Assessment indicates that the residual risk for this alternative would meet the remediation goals of limiting the cumulative excess cancer risk to human receptors to levels within or below the EPA target range for residual risk of 1E-4 to 1E-6 and limiting the cumulative noncancer hazard index to levels of 1 or less. The qualitative ecological risk assessment indicates that potential risk to ecological receptors would be low. As a result, this site presents no longer term risks to human health and the environment.

Reduction of toxicity, mobility, or volume through treatment. There is no reduction of the toxicity, mobility, or volume of soil contaminants through treatment under this alternative.

Short-term effectiveness. Because the no-action alternative involves no construction or other implementation activities, there are no short-term hazards to human health or the environment associated with this alternative.

Implementability. There are no implementability concerns for the no-action alternative.

Cost. There are no costs for the no-action alternative.

State acceptance. This criterion will be evaluated following regulatory review of this FS.

Community acceptance. This criterion will be evaluated during the public comment period that will follow release of the RI and FS reports to the community.

3.1.9.2 Alternative 2: Institutional Controls

Overall protection of human health and the environment. This alternative meets the remedial-action objectives.

Compliance with ARARs. Soils at the site meet the TSCA standard and EPA guidance for clean soil of less than 1 mg/kg PCBs. This alternative would also comply with Occupational Safety and Health Administration (OSHA) requirements for worker health and safety during construction activities. Federal and Utah State Drinking Water MCLs are met by this alternative.

Long-term effectiveness and permanence. The Baseline Risk Assessment indicates that the residual risk for this alternative would meet the remediation goals of limiting the cumulative excess cancer risk to current human receptors to levels within or below the EPA target range for residual risk of $1E-4$ to $1E-6$ and limiting the cumulative noncancer hazard index to levels of 1 or less. By using fences or other access restrictions to reduce the amount of time that on-site workers are allowed on the site, institutional controls could exceed the remediation goals by further reducing the residual excess cancer risk to on-site workers. Deed restrictions would provide for future protection in the event of release of the property to the public. The qualitative ecological risk assessment indicates that the potential risk to ecological receptors would be low. The installation of a barrier is not expected to impact the environment.

Reduction of toxicity, mobility, or volume through treatment. There is no reduction of the toxicity, mobility, or volume of soil contaminants through treatment under this alternative.

Short-term effectiveness. Human health concerns associated with the implementation of this alternative are limited to the construction hazards to personnel that would be involved with the installation of a fence or other barrier at the site. The implementation time would be sufficiently short (less than 1 month), so that the health risk due to potential exposure to site contaminants would be negligible. Wildlife is not expected to be impacted by the construction activities.

Implementability. Institutional controls involve simple activities such as the installation of fences and surveillance. This alternative is, therefore, readily implementable.

Cost. The cost to install and maintain a chain link fence around the perimeter of Site 17 is summarized below and detailed in Appendix B.

Capital: \$43,000

Annual O&M: \$650

Present Worth of O&M at 5%: \$10,000

Total Capital and Present Worth: \$53,000

The cost of implementing deed restrictions assumes the use of existing staff and is negligible.

State acceptance. This criterion will be evaluated following regulatory review of this FS.

Community acceptance. This criterion will be evaluated during the public comment period that will follow release of the RI and FS reports to the community.

3.1.9.3 *Alternative 3: Soil Cover*

Overall protection of human health and the environment. This alternative meets the remedial-action objectives.

Compliance with ARARs. This alternative meets the TSCA standard and EPA guidance for clean soil of less than 1 mg/kg PCBs. This alternative would also comply with OSHA requirements for worker health and safety (29 CFR 1910 and 29 CFR 1926) during the installation of the soil cover. The Utah Air Conservation Act (19-2-101, Citations R307-1-3.1.8(A), R-307-1-4.5.2 and R307-1-3.2) would be the action-specific ARAR to regulate fugitive dust and particulates. Federal and Utah State Safe Drinking Water Act (SDWA) MCLs are met by this alternative.

Long-term effectiveness and permanence. By placing a clean soil cover on the site, this alternative could exceed the remediation goals by further reducing the residual excess cancer risk to on-site workers. Long-term protection of the cap against erosion could be implemented, but is not included in the scope of this alternative. Risks to potential future Site 17 residents would be within the EPA carcinogenic target range. The qualitative ecological risk assessment indicates that the potential risk to ecological receptors would be low. The installation of a soil cover would not be expected to impact the environment.

Reduction of toxicity, mobility, or volume through treatment. There is no reduction of the toxicity or volume of soil contaminants through treatment under this alternative. Mobility of wind-blown soil which may contain adsorbed PCBs would be reduced by this alternative.

Short-term effectiveness. Human health concerns associated with the implementation of this alternative are limited to the construction hazards to personnel who would be involved with the installation of the soil cover at the site. The implementation time would be sufficiently

short (less than 1 month), so that the health risk due to potential exposure to site contaminants would be negligible. Dust control procedures would be implemented to contain particulate emissions during construction. Wildlife is not expected to be impacted by the construction activities.

Implementability. The placement of a soil cover over the site involves simple construction activities. Contractors are readily available. This alternative is, therefore, readily implementable.

Cost. The costs to install a soil cover over Site 17 are summarized below and detailed in Appendix B.

Capital: \$81,350
Annual O&M: 0
Present Worth of O&M at 5%: 0
Total Capital and Present Worth: \$81,350

Costs to remove and/or replace stored materials that may exist on Site 17 are not included.

State acceptance. This criterion will be evaluated following regulatory review of this FS.

Community acceptance. This criterion will be evaluated during the public comment period that will follow release of the RI and FS reports to the community.

3.1.9.4 *Alternative 4: Stabilization*

Overall protection of human health and the environment. This alternative meets the remedial-action objectives.

Compliance with ARARs. This alternative meets the EPA guidance and the TSCA PCB standard for clean soil of less than 1 mg/kg PCBs. It would greatly reduce the possibility of migration of soil contaminants to off-site receptors. This alternative would also comply with OSHA requirements for worker health and safety during stabilization. The Utah Air Conservation Act would be the action-specific ARAR to regulate fugitive dust and particulates. Federal and State SDWA MCLs would be met by this alternative.

Long-term effectiveness and permanence. By stabilizing the soils on the site, this alternative would reduce contaminant migration and potential for human or fauna contact for many years. There should be no long-term maintenance required. Since the site would be a solidified mass, future residential construction would likely be impractical without removal of the mass. In that event, clean replacement soil could be brought in and unrestricted residential development could proceed.

Reduction of toxicity, mobility, or volume through treatment. There is no reduction of toxicity under this alternative. Mobility of soil contaminants is significantly reduced. There

would be an increase in volume due to addition of the solidifying agent to the contaminated soil.

Short-term effectiveness. Human health concerns resulting from the implementation of this alternative are limited to construction hazards to personnel involved with the stabilization process. Implementation time would be 3 months, so that health risks due to exposure to contaminants would be negligible. Dust containment procedures would be implemented to control particulate emissions during construction. Wildlife may be temporarily disrupted by the stabilization activities.

Implementability. Stabilization involves proven, readily available technology, so that this alternative is readily implementable.

Cost. The cost to stabilize a 200-foot-by-350-foot-square by 5-foot-deep site are summarized below and presented in more detail in Appendix B.

Capital: \$1,717,200

Annual O&M: \$0

Present Worth of O&M at 5%: \$0

Total Capital and Present Worth: \$1,717,200

State Acceptance. This criterion will be evaluated following regulatory review of this FS.

Community Acceptance. This criterion will be evaluated during the public comment period that will follow release of the RI and FS to the community.

3.1.9.5 Alternative 5: Landfill Disposal

Overall protection of human health and the environment. Since all contamination is removed from the site to a regulated landfill, this alternative meets the remedial action objectives.

Compliance with ARARs. This alternative meets the EPA guidance and TSCA PCB standards for clean soil of less than 1 mg/kg PCBs. This alternative would also comply with OSHA requirements for worker health and safety during soil handling. The Utah Air Conservation Act would be the action-specific ARAR to regulate fugitive dust and particulates. The Utah Solid and Hazardous Waste Act (19-6-01); the Utah Solid Waste Management Act; 40 CFR Part 268, Landfill Disposal Restrictions; the Hazardous Materials Transport Act; and State and Federal MCLs would also be ARARs.

Long-term effectiveness and permanence. Since all contaminants are removed from the site, this alternative would be a permanent solution as regards TEAD-N. The contaminants would still be in existence, but at a landfill site with controls to protect human health and the environment.

Reduction of toxicity, mobility, or volume through treatment. The strategy chosen for this alternative would eliminate the contaminant toxicity, mobility, and volume from the site, but the waste load of the landfill would be increased so that there is no reduction of toxicity, mobility, or volume through treatment under this alternative.

Short-term effectiveness. Human health concerns resulting from the implementation of this alternative are limited to construction hazards to personnel. Implementation time would be short, so that the health risk due to exposure to PCB would be negligible. Dust control during excavation, hauling, and backfill operations would contain particulate emissions. Wildlife may be temporarily disrupted by the construction activity.

Implementability. Contractors and appropriate equipment are readily available for this construction work.

Cost. The cost to implement this alternative are summarized below and presented in more detail in Appendix B.

Capital: \$1,167,000

Annual O&M: \$0

Present Worth of O&M @ 5%: \$0

Total Capital and Present Worth: \$1,167,000

State Acceptance. This criterion will be evaluated following final regulatory review of this FS.

Community Acceptance. This criterion will be evaluated during the public comment period that will follow release of the RI and FS to the community.

3.1.9.6 Alternative 6: Incineration

Overall protection of human health and the environment. Essentially all of the PCB contamination would be permanently destroyed by incineration so that the remedial action objective would be exceeded.

Compliance with ARARs. This alternative meets the EPA guidance and TSCA PCB standards for clean soil of less than 1 mg/kg PCBs. This alternative would also comply with OSHA requirements for worker health and safety during soil handling. The Utah Air Conservation Act would be the action-specific ARAR to regulate fugitive dust and particulates. The Utah Solid and Hazardous Waste Act (19-6-01); the Utah Solid Waste Management Act; 40 CFR Part 268, Landfill Disposal Restrictions; the Hazardous Materials Transport Act; and State and Federal MCLs would also be ARARs.

Long-term effectiveness and permanence. Essentially all of the PCBs would be permanently destroyed by incineration.

Reduction of toxicity, mobility, or volume through treatment. The toxicity, mobility, and volume of the PCBs would be effectively eliminated by incineration. The volume of incinerator ash to be disposed would be essentially the same as the original soil volume.

Short-term effectiveness. Human health concerns resulting from the implementation of this alternative are limited to construction hazards to personnel. Implementation time would be short, so that the health risk due to exposure to PCB would be negligible. Dust control during excavation, hauling, and backfill operations would contain particulate emissions. Wildlife may be temporarily disrupted by the construction activity.

Implementability. Contractors and equipment are readily available to excavate, backfill, and haul the soils. A TSCA-permitted incinerator is available in the Tooele area. Further characterization and perhaps batch testing of incineration may be required because of the very low concentration of PCBs in Site 17 soil.

Cost. The costs to excavate, haul the soil, test the soil, incinerate, haul in backfill, and place backfill are summarized below and presented in more detail in Appendix B.

Capital: \$26,500,000

Annual O&M: \$0

Present Worth of O&M at 5%: \$0

Total Capital and Present Worth: \$26,500,000

State Acceptance. This criterion will be evaluated following final regulatory review of this FS.

Community Acceptance. This criterion will be evaluated during the public comment period that will follow release of the RI and FS to the community.

3.1.10 Comparative Analysis of Remedial Alternatives for Soils

Table 3-6 provides a comparative analysis of Alternatives 1 through 6 for Site 17.

3.1.11 Remedial-Action Objectives for Groundwater

The only contaminant of concern for Site 17 is PCB 1260, and the only potential route of exposure from contaminated groundwater is via existing or future downgradient wells. The nearest existing on-site water-supply well is WW-2, which is approximately 3,000 feet from Site 17, but not directly downgradient of the site. A potential does exist for contamination of the groundwater through leaching of PCB from the soil by infiltration of precipitation. However, PCBs tend to adsorb strongly to soils. This, coupled with the estimated depth to groundwater below Site 17 of 280 feet and the low concentrations found, makes it unlikely that groundwater contamination would occur.

Table 3-6. Comparative Analysis of Remedial Alternatives for Site 17 Soils

Criterion	Alternative 1: No Action	Alternative 2: Institutional Controls	Alternative 3: Soil Cover	Alternative 4: Stabilization	Alternative 5: Landfill Disposal	Alternative 6: Incineration
Overall Protection	Meets the remedial-action objectives of protecting human health and the environment.	Meets the remedial-action objectives of protecting human health and the environment.	Meets the remedial-action objectives of protecting human health and the environment.	Meets the remedial-action objectives of protecting human health and the environment.	Meets the remedial-action objectives of protecting human health and the environment.	Meets the remedial-action objectives of protecting human health and the environment.
Compliance with ARARs ^(a)	Also meets the TSCA ^(b) and EPA standards for a clean soil of less than 1 mg/kg PCBs. Meets SDWA MCLs.	Also meets the TSCA and EPA standards for a clean soil of less than 1 mg/kg PCBs. Would meet OSHA ^(c) requirements for worker health and safety during implementation. Meets SDWA MCLs.	Also meets the TSCA and EPA standards for a clean soil of less than 1 mg/kg PCBs. Would meet OSHA requirements for worker health and safety during implementation. Meets SDWA MCLs.	Also meets the TSCA and EPA standards for a clean soil of less than 1 mg/kg PCBs. Would meet OSHA requirements for worker health and safety during implementation. Meets SDWA MCLs.	Also meets the TSCA and EPA standards for a clean soil of less than 1 mg/kg PCBs. Would meet OSHA requirements for worker health and safety during implementation. Also meets State and Federal Land Disposal and Hazardous Waste Handling regulations. Meets SDWA MCLs.	Also meets the TSCA and EPA standards for a clean soil of less than 1 mg/kg PCBs. Would meet OSHA requirements for worker health and safety during implementation. Also meets State and Federal Land Disposal and Hazardous Waste Handling regulations. Meets SDWA MCLs.
Long-Term Effectiveness	Would meet the remediation goals of limiting the cumulative excess cancer risk to human receptors to levels within or below the EPA target range for residual risk of 1E-4 to 1E-6 and limiting the cumulative noncancer hazard index to levels of 1 or less. The qualitative risk to ecological receptors would be low.	Would meet the remediation goals of limiting the cumulative excess cancer risk to human receptors to levels within or below the EPA target range for residual risk of 1E-4 to 1E-6 and limiting the cumulative noncancer hazard index to levels of 1 or less. The qualitative risk to ecological receptors would be low.	Would meet the remediation goals of limiting the cumulative excess cancer risk to human receptors to levels within or below the EPA target range for residual risk of 1E-4 to 1E-6 and limiting the cumulative noncancer hazard index to levels of 1 or less. The qualitative risk to ecological receptors would be low.	Would meet the remediation goals of limiting the cumulative excess cancer risk to human receptors to levels within or below the EPA target range for residual risk of 1E-4 to 1E-6 and limiting the cumulative noncancer hazard index to levels of 1 or less. The qualitative risk to ecological receptors would be low.	Would meet the remediation goals of limiting the cumulative excess cancer risk to human receptors to levels within or below the EPA target range for residual risk of 1E-4 to 1E-6 and limiting the cumulative noncancer hazard index to levels of 1 or less. The qualitative risk to ecological receptors would be low.	Would meet the remediation goals of limiting the cumulative excess cancer risk to human receptors to levels within or below the EPA target range for residual risk of 1E-4 to 1E-6 and limiting the cumulative noncancer hazard index to levels of 1 or less. The qualitative risk to ecological receptors would be low.
Reduction of Toxicity, Mobility, and Volume	There is no reduction of the toxicity, mobility, or volume of soil contaminants through treatment under this alternative.	There is no reduction of the toxicity, mobility, or volume of soil contaminants through treatment under this alternative.	There is no reduction of the toxicity, mobility, or volume of soil contaminants through treatment under this alternative.	There is no reduction of the toxicity with this treatment. Mobility of contaminants is significantly reduced. There is an overall increase in volume due to the addition of solidifying agent.	There is no reduction of the toxicity, mobility, or volume of soil contaminants through treatment under this alternative.	Toxicity and mobility of contamination are permanently removed by this alternative. Waste volume is unchanged.

Table 3-6. Comparative Analysis of Remedial Alternatives for Site 17 Soils (continued)

Criterion	Alternative 1: No Action	Alternative 2: Institutional Controls	Alternative 3: Soil Cover	Alternative 4: Stabilization	Alternative 5: Landfill Disposal	Alternative 6: Incineration
Short-Term Effectiveness	There are no short-term hazards to human health or the environment associated with this alternative.	Health concerns are the construction hazards associated with installation of a fence or other barrier. No disruption of wildlife is expected.	Health concerns are the construction hazards associated with installation of the soil cover. Temporary disruption of wildlife may occur during construction.	Health concerns are the construction hazards associated with the stabilization process. Temporary disruption of wildlife may occur during stabilization.	Health concerns are the construction hazards associated with the soil removal, haulage, and backfill. Temporary disruption of wildlife may occur during construction.	Health concerns are the construction hazards associated with the soil removal, haulage, and backfill. Temporary disruption of wildlife may occur during construction.
Implementability	There are no implementability concerns.	Readily implementable.	Readily implementable.	Readily implementable.	Readily implementable.	Readily implementable.
Cost	No cost.	Capital: \$43,000 O&M/yr ^(a) : \$650 PW ^(c) @ 5%: \$10,000 Total: \$53,000	Capital: \$81,350 O&M/yr: 0 PW @ 5%: 0 Total: \$81,350	Capital: \$1,717,200 O&M/yr: 0 PW @ 5%: 0 Total: \$1,717,200	Capital: \$1,167,000 O&M/yr: 0 PW @ 5%: 0 Total: \$1,167,000	Capital: \$26,500,000 O&M/yr: 0 PW @ 5%: 0 Total: \$26,500,000
State Acceptance	To be evaluated following regulatory review of this FS.	To be evaluated following regulatory review of this FS.	To be evaluated following regulatory review of this FS.	To be evaluated following regulatory review of this FS.	To be evaluated following regulatory review of this FS.	To be evaluated following regulatory review of this FS.
Community Acceptance	To be evaluated during the public comment period that will follow release of the RI and FS reports to the community.	To be evaluated during the public comment period that will follow release of the RI and FS reports to the community.	To be evaluated during the public comment period that will follow release of the RI and FS reports to the community.	To be evaluated during the public comment period that will follow release of the RI and FS reports to the community.	To be evaluated during the public comment period that will follow release of the RI and FS reports to the community.	To be evaluated during the public comment period that will follow release of the RI and FS reports to the community.

^(a)ARARs = Applicable or Relevant and Appropriate Requirements.

^(b)TSCA = Toxic Substances Control Act.

^(c)OSHA = Occupational Safety and Health Act.

^(d)O&M/yr = operation and maintenance/year.

^(e)PW = present worth.

The groundwater remedial-action objective for Site 17 would be to reduce PCB concentrations to below the maximum contaminant level (MCL) of 0.0005 milligrams per liter (mg/l), which could be met through source control and remediation as necessary. Meeting this objective reduces risk to human health to acceptable levels and maintains the quality of water for future use. The RI and Baseline Risk Assessment for Site 17 indicate that the current condition of the site meets this remedial-action objective.

3.1.12 General Response Actions for Groundwater

Although available information indicates that the current condition of the site meets the remedial-action objective and remediation is not required, remedial technologies have been identified in conformance with regulatory processes. The following are the general response actions identified for Site 17 groundwater:

- No action
- Monitoring
- Institutional controls
- Extraction followed by treatment

3.1.13 Identification and Screening of Remedial Technologies for Groundwater

Table 3-7 identifies and screens possible remedial technologies according to effectiveness, implementability, and cost. The No Action alternative is the only one chosen for development because current information indicates that groundwater contamination does not pose a human health or environmental risk at Site 17.

3.1.14 Detailed Analysis of No-Action Alternative for Groundwater

Overall protection of human health and the environment. This alternative meets the remedial-action objective.

Compliance with ARARs. Drinking water MCL for PCB is met by this alternative. The Federal SDWA, Utah Groundwater Protection Rule, and Utah SDWA are all ARARs which are met by the No Action Alternative.

Long term effectiveness and permanence. According to EPA guidance, if soils are below action levels, this is generally taken to mean that groundwater is sufficiently protected (EPA, 1990b).

Reduction of toxicity, mobility, or volume through treatment. There is no reduction of toxicity, mobility, or volume of groundwater contaminants through treatment under this alternative.

Table 3-7. Technology Screening for Groundwater at Site 17

Technology	Effectiveness	Implementability	Cost	Screening Results
No Action	Effective because contamination levels are in compliance with regulations and do not pose an excessive human health or environmental risk.	NA ^(a)	No cost.	Consider.
Monitoring	Effectively protect human health and environment by monitoring new or existing downgradient wells. Does not reduce contamination.	Readily implementable. ^(b)	Low cost for sampling and analysis. Higher cost if additional wells required.	Eliminate because of no indication of PCB in groundwater.
Institutional Controls				
Permit Restrictions Shutdown wells Provide alternate water supply	Long-term enforcement necessary to protect human health and the environment. Does not reduce contamination.	Readily implementable.	Low to moderate costs depending on availability of alternate water sources.	Eliminate because of no indication of PCB in groundwater.
Extraction Followed by Treatment	Effectiveness depends on successful capture of groundwater.	Technology and manpower are available.	High cost.	Eliminate because of no indication of PCB in groundwater.

^aNA = not applicable.

^bReadily implementable technologies are those for which services or vendors are available.

Short-term effectiveness. There are no short-term hazards associated with this alternative.

Implementability. There are no implementability concerns associated with the no-action alternative.

Cost. There are no costs for this alternative.

State acceptance. This criterion will be evaluated following regulatory review of the FS.

Community acceptance. This criterion will be evaluated during the public comment period that will follow release of the RI and FS reports to the community.

3.2 PCB STORAGE BUILDING 659 (SITE 33)

3.2.1 Site Description

The PCB Storage Facility in Building 659 at TEAD-N is a TSCA-permitted facility used to store transformers. The facility has a sealed cement floor and has a perimeter berm and diversion structures at each entrance for the containment of oil spills. Much of the surface around the building is paved (EA, 1988). The facility began operating in 1979 and is used to store thousands of transformers that were once stored in open storage sites. The transformers are stored on open pallets and in wooden crates within the building. According to a discussion with facility personnel during a site visit in November 1992, PCB-contaminated transformers are still being removed from TEAD-N, with temporary storage occurring at Building 659 during the removal process. During the site visit, no PCB-contaminated transformers were being stored at the facility.

3.2.2 Nature and Extent of Contamination

There have been no previous investigations at the PCB Storage Building 659. No RI activities were conducted at this site because facility operation is conducted in compliance with a TSCA permit, and there is no evidence or data to indicate that PCB-contaminated wastes have been released from the building to the environment in the vicinity of Building 659.

PCB spills have occurred at Site 33. The contaminated cleanup materials such as oil absorbent and protective clothing were drummed, appropriately marked, and stored for disposal (EA, 1988). PCB disposal is managed by the Defense Reutilization and Marketing Office (DRMO) and conducted by U.S. Pollution Control, Inc., of West Murray, Utah. Soil and dust are collected during periodic sweep downs of the building and are properly drummed and disposed of. Because the facility is TSCA-permitted, well maintained and operated, and all spills properly cleaned up and contained, releases from the facility are unlikely.

There is no evidence or data to indicate that PCB-contaminated wastes have ever been released from the building to the environment due to operation at Site 33. For instance, a 1981 PCB Inspection Report conducted by EPA personnel showed that:

- Although three transformers had been placed inside the building, outside the bermed area (i.e., outside the permitted storage area) no leakage or PCB contamination had occurred. The transformers were moved inside the permitted area following the inspection.
- Analysis of a sample taken from an oil stain just outside a Building 659 outside door showed less than 1 ppm PCB.
- Although the berm had been damaged, it was appropriately repaired.

A copy of the correspondence related to this inspection is provided as Appendix C to this document.

PCBs are the potential contaminants of concern at this site. However, there are no indications that a release of PCB-contaminated oil to the environment has occurred at this site.

3.2.3 Contaminant Fate and Transport

Because there were no indications of a contaminant release at this site, an assessment of contaminant fate and transport characteristics and of exposure pathways was not conducted.

3.2.4 Summary of the Baseline Risk Assessment

3.2.4.1 *Human Health Risk Assessment*

Because there were no indications of a contaminant release at this site, a human health evaluation for Site 33 was not conducted.

3.2.4.2 *Ecological Risk Evaluation*

Site 33 is a storage facility inside a building in an industrial area of TEAD-N. There is no vegetation at the site. Because the site is well-maintained and there is frequent human activity, it is unlikely that any wildlife with the exception of occasional small mammals (such as rodents) inhabit the site.

No contaminants of concern were identified for Site 33. Therefore, an assessment of biological effects was not performed.

3.2.5 Remedial-Action Objectives

The following risk-based remediation levels are the remediation goals for Site 33: (1) limit the cumulative excess cancer risk to human receptors to levels within or below the EPA target range for residual risk of $1\text{E-}4$ to $1\text{E-}6$ and (2) limit the cumulative noncancer hazard index to levels of 1 or less. The remedial-action objectives for Site 33 are to: (1) prevent human and environmental (i.e., fauna and flora) exposure to soil contamination that is present at concentrations above the risk-based remediation levels and (2) prevent migration of soil contaminants that may be present at concentrations above the risk-based remediation levels to surface water and groundwater. There are no indications that PCBs have been released to soils at Site 33, so available data indicate that the current condition of the site meets the remedial-action objectives.

3.2.6 General Response Actions for Soils and Groundwater

Because there is no indication of contamination at Site 33, none of the soils at the site require remediation. The only general response action is no action. According to EPA guidance, if soils are below action levels, groundwater can generally be considered protected (EPA, 1990b).

3.3.7 Identification and Screening of Remedial Technologies

Because there are no indications of a contaminant release at Site 33, no remedial technologies have been identified. Screening elements leading to consideration of a no-action alternative are as follows:

- **Effectiveness.** There is no indication of contamination at Site 33 that would endanger human health or the environment. As long as the facility remains under Army control with TSCA permits in place, there is little possibility of contamination occurring. If, as stated in Section 1.3.1 of this FS, the facility's purpose were to be changed from PCB storage or the facility were to be transferred from Army control, a examination and evaluation would take place prior to any such change under TSCA rules and BRAC requirements. Human health and the environment would continue to be protected.
- **Implementability.** No implementation required for no action.
- **Cost.** There would be no cost for a no-action alternative.

3.2.8 Development of Remedial Alternatives

Because there are no indications of a contaminant release at Site 33, no action is the only remedial alternative that is being considered.

3.2.9 Detailed Analysis of No-Action Alternative

Overall protection of human health and the environment. There are no indications that this site now poses a threat to human health or the environment or will as long as it remains as a TSCA-permitted facility under Army control.

Compliance with ARARs. No ARARs have been identified for Site 33 because there are no indications of a contaminant release at this site.

Long-term effectiveness and permanence. There are no indications that the soils at this site pose a long-term threat to human health or the environment. As stated above, if the site were to be transferred from Army control or the principal use of the facility changed from PCB storage, a complete examination and evaluation under TSCA and the BRAC process are mandated to ensure continued protection of human health and the environment.

Reduction of toxicity, mobility, or volume through treatment. There are no indications of the presence of soil contamination at this site.

Short-term effectiveness. Because the no-action alternative involves no construction or other implementation activities, there are no short-term hazards to human health or the environment associated with this alternative.

Implementability. There are no implementability concerns for the no-action alternative.

Cost. There are no costs for the no-action alternative.

State acceptance. This criterion will be evaluated following regulatory review of this FS.

Community acceptance. This criterion will be evaluated during the public comment period that will follow release of the RI and FS reports to the community.

4.0 OPERABLE UNIT 6

OU 6 is located in the eastern portion of TEAD-N in an area referred to as the Maintenance Area. This OU consists of two sites: the Drummed Radioactive Waste Storage Area (Site 9) and the Radioactive Waste Storage Area (Site 18). Site 9 consists of the area used for temporary storage of drummed low-level radioactive waste, which was located at the site from approximately 1960 to 1978. Site 18 is a NRC-licensed facility for the storage of radioactive materials and is located in the northeastern corner of Building 659.

4.1 DRUMMED RADIOACTIVE WASTE STORAGE AREA (SITE 9)

4.1.1 Site Description

The Drummed Radioactive Waste Storage Area (Site 9) consists of a concrete pad and an adjacent field area that were used for the temporary storage of containerized low-level radioactive waste. The material was stored for a number of years on or around a concrete pad southwest of Building S-753 (Figure 4-1). It was then moved to a field area northwest of Building S-753. In 1978, the material was removed for off-site disposal by the TEAD-N Radiation Protection Office. The materials reportedly included transmitting tubes used to generate microwaves for radar systems and possibly speedometers, luminous watch dials, contaminated tools, and decontamination materials. Previous investigations (USATHAMA, 1979 and NUS, 1987) reported a list of radioactive isotopes that may have been present at TEAD-N and, consequently, may have been present in the drummed wastes, as follows: iridium-192, cobalt-60, nickel-63, carbon-14, polonium-210, cesium-139, hydrogen-3, promethium-147, krypton-85, plutonium-239, and radium-226.

There are no records that identify the exact storage locations of the containerized waste and no indication that any radioactive spills may have occurred at this location. Currently, a small wooden storage shed is located on the concrete pad thought to have been used for container storage. The field to which one drum was suspected to have been moved includes Lot 707, which is an area now used for storage of 4-wheel-drive pickup trucks. Because Site 9 is in an industrial area, the site is sparsely vegetated. Except for occasional transient species, the most likely wildlife inhabitants are rodents, other small mammals, and birds. There is no indication that this site is a critical habitat for wildlife.

4.1.2 Nature and Extent of Contamination

During the RI, radiological contamination surveys were conducted in all areas suspected to have been locations for the storage of radioactive waste containers. The results of these surveys show that there are no locations of elevated radiation within the suspected storage areas. Consequently, there are no contaminants of concern for Site 9.

4.1.3 Contaminant Fate and Transport

Because there were no contaminants of concern for Site 9, an assessment of the contaminant fate and transport characteristics was not conducted.

4.1.4 Summary of the Baseline Risk Assessment

Because there were no indications of a contaminant release at Site 9, a risk assessment for this site was not performed during the RI.

4.1.5 Remedial-Action Objectives for Soils

The following risk-based remediation levels are the remediation goals for Site 9: (1) limit the cumulative excess cancer risk to human receptors to levels within or below the EPA target range for residual risk of $1\text{E-}4$ to $1\text{E-}6$, (2) limit the cumulative noncancer hazard index to levels of 1 or less, and (3) prevent long-term exposure to radiation. The remedial-action objectives for Site 9 soils are to (1) prevent human and environmental (i.e., fauna and flora) exposure to soil contamination that is present at concentrations above the risk-based remediation levels and (2) prevent migration of soil contaminants that are present at concentrations above the risk-based remediation levels to surface water and groundwater. There are no indications that contaminants have been released to soils at Site 9, so the available data indicate that the current condition of the site meets the remedial-action objectives.

4.1.6 General Response Actions for Soils

General response actions considered prior to the RI, and thus based on the possibility that contamination might be detected, included:

- No action
- Institutional controls
- Containment
- In-situ treatment
- Excavation followed by on-site treatment and disposal
- Excavation followed by off-site treatment and/or disposal

However, because there is no indication of contamination at Site 9, none of the soils at the site require remediation. The only general response action is no action.

4.1.7 Identification and Screening of Remedial Technologies for Soils

Remedial technologies exist for soils at Site 9. Table 4-1 identifies and screens these technologies according to effectiveness, implementability, and cost. Since no contaminants have been identified at Site 9, the no-action alternative is the only one that is retained.

4.1.8 Development of Remedial Alternatives for Soils

Because there are no indications of a contaminant release at Site 9, no action is the only remedial alternative that is being considered.

4.1.9 Detailed Analysis of No-Action Alternative for Soils

Overall protection of human health and the environment. There are no indications that this site poses a threat to human health or the environment.

Compliance with ARARs. No ARARs have been identified for Site 9 because there are no indications of a contaminant release at this site.

Long-term effectiveness and permanence. There are no indications that the soils at this site pose a long-term threat to human health or the environment.

Reduction of toxicity, mobility, or volume through treatment. There are no indications of the presence of soil contamination at this site.

Short-term effectiveness. Because the no-action alternative involves no construction or other implementation activities, there are no short-term hazards to human health or the environment associated with this alternative.

Implementability. There are no implementability concerns for the no-action alternative.

Cost. There are no costs for the no-action alternative.

State acceptance. This criterion will be evaluated following regulatory review of this FS.

Community acceptance. This criterion will be evaluated during the public comment period that will follow release of the RI and FS reports to the community.

4.1.10 Remedial-Action Objectives for Groundwater

There is no indication of contamination on Site 9. Further, the depth to groundwater beneath the site is approximately 230 feet. Thus, there appears to be no possibility of groundwater contamination resulting from Site 9.

Table 4-1. Technology Screening for Potentially Contaminated Soils at Sites 9 and 18

Technology	Effectiveness	Implementability	Cost	Screening Results
No Action	Effective because there is no indication of contamination at this site.	NA ^(a)	No cost.	Consider. Required for consideration by the NCP.
Institutional Controls				
Deed Restrictions	As long as the sites are Army property, deed restrictions are not necessary to control the use of the land. Does not reduce contamination.	Readily implementable. ^(b)	Negligible cost.	Eliminate.
Fences	Legal authority and long-term enforcement necessary. Does not reduce contamination.	Readily implementable.	Low cost. \$25/LF. ^(c)	Eliminate.
Soil Sampling and Analysis	Does not reduce contamination and does not prevent exposure. May require use with other technologies to provide protection of human health and environment.	Readily implementable.	Low cost. Approximately \$500 to \$1000/sample.	Eliminate.
Containment				
Surface Runoff Controls	Does not reduce contamination or prevent exposure of humans, fauna, and flora. Reduces potential for contaminant migration through erosion and leaching. Long-term maintenance and institutional controls necessary.	Readily implementable.	Low cost. Less than or comparable to capping.	Eliminate. Surface water runoff is not a concern at this site.
Capping	Does not reduce contamination. Prevents exposure of humans, fauna, and flora. Prevents erosion and infiltration of water. Long term maintenance and institutional controls necessary.	Readily implementable.	Low cost. \$10 to \$70/SY. ^(d)	Eliminate.

Table 4-1. Technology Screening for Potentially Contaminated Soils at Sites 9 and 18 (continued)

Technology	Effectiveness	Implementability	Cost	Screening Results
In-situ Treatment				
Biodegradation	Not appropriate for COCs ^(e) (radioactive isotopes).	NA	NA	Eliminate.
Radio Frequency Heating	Not appropriate for COCs (radioactive isotopes).	NA	NA	Eliminate.
Soil Vapor Extraction	Not appropriate for COCs (radioactive isotopes).	NA	NA	Eliminate.
Stabilization	Creates a solid monolith that is resistant to leaching. Does not reduce contaminant toxicity or volume.	Readily implementable.	Low cost. \$30 + /ton	Eliminate because of lack of contamination.
Vitrification	Creates a solid, glassy monolith that is highly resistant to leaching. Reduces contaminant volume and mobility but does not reduce toxicity.	Only one vendor is available.	High cost due to high energy consumption.	Eliminate.
Excavation and On-Site Treatment and Disposal				
Biological Treatment	Not appropriate for COCs (radioactive isotopes).	NA	NA	Eliminate.
Chemical Extraction	Not appropriate for COCs (radioactive isotopes).	NA	NA	Eliminate.
Dechlorination	Not appropriate for COCs (radioactive isotopes).	NA	NA	Eliminate.
Detonation	Not appropriate for COCs (radioactive isotopes).	NA	NA	Eliminate.
Incineration	Not appropriate for COCs (radioactive isotopes).	NA	NA	Eliminate.
Open Burning	Not appropriate for COCs (radioactive isotopes).	NA	NA	Eliminate.

Table 4-1. Technology Screening for Potentially Contaminated Soils at Sites 9 and 18 (continued)

Technology	Effectiveness	Implementability	Cost	Screening Results
Physical Separation	Reduces contaminant volume by separating out the fine-grained materials (assuming contaminants are adsorbed to silts and clays). Reductions of toxicity and mobility are dependent upon secondary treatment of the fine-grained materials.	Readily implementable.	Low to moderate cost. Less than or comparable to soil washing.	Eliminate because of lack of contamination.
Soil Washing	Reduces contaminant volume by separating out the fine-grained materials (assuming contaminants are adsorbed to silts and clays). Reductions of toxicity and mobility are dependent upon secondary treatment of the fine-grained materials. Generates wastewater that may require treatment.	Readily implementable.	Moderate cost. \$40 to \$50/ton.	Eliminate because of lack of contamination.
Stabilization	Creates a solid monolith that is resistant to leaching. Does not reduce contaminant toxicity or volume.	Readily implementable.	Low to high cost. \$30 to \$250/ton.	Eliminate because of lack of contamination.
Thermal Desorption	Not appropriate for COCs (radioactive isotopes).	NA	NA	Eliminate.
Volatilization	Not appropriate for COCs (radioactive isotopes).	NA	NA	Eliminate.
Excavation and Off-Site Treatment and/or Disposal				
Incineration	Not appropriate for COCs (radioactive isotopes).	NA	NA	Eliminate.

Table 4-1. Technology Screening for Potentially Contaminated Soils at Sites 9 and 18 (continued)

Technology	Effectiveness	Implementability	Cost	Screening Results
Landfill	Removes contaminated soil from the site and eliminates the need for long-term maintenance. Safe excavation and transport are short-term concerns. Long-term effectiveness depends on pretreatment and disposal practices at the receiving facility.	Readily implementable. Requires disposal at a NRC-licensed facility for the disposal of low-level radioactive waste.	Moderate to high cost.	Eliminate because of lack of contamination.

^aNA = not applicable.

^bReadily implementable technologies are those for which services or vendors are available.

^cLF = linear foot.

^dSY = square yard.

^eCOCs = contaminants of concern.

Remedial-action objectives for groundwater at Site 9 would be to prevent human and environmental (i.e., fauna and flora) exposure to groundwater contamination that is present above risk-based remediation levels or MCLs. The remedial investigation for Site 9 indicates that the current condition of the site meets these remedial-action objectives.

4.1.11 General Response Actions for Groundwater

Although available information indicates that the current condition of the site meets remedial-action objectives and remediation is not required, remedial technologies have been identified in conformance with regulatory processes. The general response actions identified for Site 9 groundwater are:

- No action
- Monitoring
- Institutional controls
- Extraction followed by treatment
- Containment

4.1.12 Identification and Screening of Remedial Technologies for Groundwater

Table 4-2 identifies and screens possible remedial technologies according to effectiveness, implementability, and cost. The no-action alternative is the only one chosen for development because there is no indication of contamination at Site 9.

4.1.13 Detailed Analysis of No-Action Alternative for Groundwater

Overall protection of human health and the environment. This alternative meets the remedial-action objectives.

Compliance with ARARs. Drinking water MCLs are met by this alternative.

Long term effectiveness and permanence. This alternative would be protective of human health and the environment over the long term.

Reduction of toxicity, mobility, or volume through treatment. There is no reduction of toxicity, mobility, or volume of groundwater contaminants through treatment under this alternative.

Short-term effectiveness. There are no short-term hazards associated with this alternative.

Implementability. There are no implementability concerns associated with the no-action alternative.

Table 4-2. Technology Screening for Groundwater at Sites 9 and 18

Technology	Effectiveness	Implementability	Cost	Screening Results
No Action	Effective because there is no indication of contamination at this site.	NA ^(a)	No cost.	Consider.
Monitoring	Effectively protect human health and environment by monitoring new or existing downgradient wells. Does not reduce contamination.	Readily implementable. ^(b)	Low cost for sampling and analysis. Higher cost if additional wells required.	Eliminate because of no indication of contamination in groundwater.
Institutional Controls				
Permit Restrictions Shutdown wells Provide alternate water supply	Long-term enforcement necessary to protect human health and the environment. Does not reduce contamination.	Readily implementable.	Low to moderate costs depending on availability of alternate water sources.	Eliminate because of no indication of contamination in groundwater.
Extraction Followed by Treatment	Effectiveness depends on successful capture of groundwater.	Technology and manpower are available.	High cost.	Eliminate because of no indication of contamination in groundwater.
Containment	Would reduce potential contaminant migration, but does not reduce contamination volume.	Vertical barriers infeasible due to great depth to groundwater.	High cost.	Eliminate because of depth to groundwater and no indication of contamination.

^aNA = not applicable.

^bReadily implementable technologies are those for which services or vendors are available.

Cost. There are no costs for this alternative.

State acceptance. This criterion will be evaluated following regulatory review of this FS.

Community acceptance. This criterion will be evaluated during the public comment period that will follow release of the RI and FS reports to the community.

4.2 RADIOACTIVE WASTE STORAGE BUILDING (SITE 18)

4.2.1 Site Description

The Radioactive Waste Storage Building (Site 18) is in the northeastern corner of Building 659 (Figure 4-2), which is also the building used for the storage of transformers (Site 33). Site 18 consists of a secured room within Building 659 and is a NRC-licensed facility for storage of radioactive materials. The building has a bermed concrete floor, and the secured room is enclosed and isolated from the remainder of the building. Materials stored in the storage area include radiation-detection meters, compasses, sights, range finders, and radioactive luminous compounds. Specific constituents associated with storage include or have included tritium, radium, and uranium-238 (EA,1988). The wastes are stored in Department of Transportation (DOT)-approved containers. Periodic monitoring of the facility is conducted to determine if radioactive releases have occurred. Access to the facility is controlled by a locked entry door.

4.2.2 Nature and Extent of Contamination

Radiation surveys are conducted periodically at Site 18. No indications of uncontrolled releases have been reported to date. Consequently, there are no contaminants of concern for Site 18.

4.2.3 Contaminant Fate and Transport

Because there were no contaminants of concern for Site 18, an assessment of contaminant fate and transport characteristics was not conducted.

4.2.4 Summary of the Baseline Risk Assessment

Because there were no indications of a contaminant release at Site 18, a risk assessment for this site was not performed during the RI.

4.2.5 Remedial-Action Objectives for Soils

The following risk-based remediation levels are the remediation goals for Site 18: (1) limit the cumulative excess cancer risk to human receptors to levels within or below the EPA target range for residual risk of $1\text{E-}4$ to $1\text{E-}6$, (2) limit the cumulative noncancer hazard index to levels of 1 or less, and (3) prevent long-term exposure to gamma radiation. The remedial-action objectives for Site 18 soils are to (1) prevent human and environmental (i.e., fauna and flora) exposure to soil contamination that is present at concentrations above the risk-based remediation levels and (2) prevent migration of soil contaminants that are present at concentrations above the risk-based remediation levels to surface water and groundwater. There are no indications that contaminants have been released to the environment at Site 18; available data indicate that the current condition of the site meets the remedial-action objectives.

4.2.6 General Response Actions for Soils

General response actions considered prior to the RI, and thus based on the possibility that contamination might be detected, included:

- No action
- Institutional controls
- Containment
- In-situ treatment
- Excavation followed by on-site treatment and disposal
- Excavation followed by off-site treatment and/or disposal

However, because there is no indication of contamination at Site 18, none of the soils at the site require remediation. The only general response action is no action.

4.2.7 Identification and Screening of Remedial Technologies for Soils

Remedial technologies exist for any potentially contaminated soils at Site 18. Table 4-1 identifies these technologies. Since no contamination has been identified at Site 18, the effectiveness, implementation, and cost screening results in retention of only the no-action alternative. As long as the facility remains under Army jurisdiction with NRC licenses in place, there is very little possibility of contamination occurring. If, as stated in Section 1.3.1 of this FS, the facility's purpose were to be changed from radioactive material storage or the facility were to be transferred from Army control, an examination and evaluation would take place prior to any such change under NRC rules and BRAC requirements. Human health and the environment would continue to be protected.

4.2.8 Development of Remedial Alternatives for Soils

Because there are no indications of a contaminant release at Site 18, no action is the only remedial alternative that is being considered. Site 18 is presently regulated under the NRC. Operations under the NRC license include continued monitoring and access restrictions; these controls would remain in effect at the facility as long as radioactive materials are stored there. Any future closure of the facility would be completed under NRC closure requirements, as well as Army BRAC requirements and EPA mandates.

4.2.9 Detailed Analysis of No-Action Alternative for Soils

Overall protection of human health and the environment. Available information indicates that this NRC-licensed facility is properly operated, and there is no evidence that releases of radioactive contaminants have occurred. Because of the extensive regulatory design and operational oversight required by the NRC, human health and the environment are being adequately protected at Site 18 and will continue to be protected as long as the site remains a NRC-licensed facility under Army control.

Compliance with ARARs. Drinking water MCLs are chemical-specific ARARs for this site and are currently being attained. No other ARARs have been identified under CERCLA for Site 18 because there are no indications of a contaminant release to the environment at this site. Continued operation and any future closure of Site 18 will be regulated by the NRC.

Long-term effectiveness and permanence. As long as Site 18 is maintained under the existing NRC regulations, protection of human health and the environment will be maintained. Any future closure of the facility would be completed under NRC, EPA, and BRAC requirements.

Reduction of toxicity, mobility, or volume through treatment. There are no indications of soil contamination at this site.

Short-term effectiveness. Because the no-action alternative involves no construction or other implementation activities, there are no short-term hazards associated with this alternative.

Implementability. There are no implementability concerns for the no-action alternative.

Cost. There are no costs for the no-action alternative.

State acceptance. This criterion will be evaluated following regulatory review of this FS.

Community acceptance. This criterion will be evaluated during the public comment period that will follow release of the RI and FS reports to the community.

4.2.10 Remedial-Action Objectives for Groundwater

There is no indication of contamination on Site 18. Further, the depth to groundwater beneath the site is approximately 230 feet. Thus, there appears to be no possibility of groundwater contamination resulting from Site 18.

Remedial-action objectives for groundwater at Site 18 are to prevent human and environmental (i.e., fauna and flora) exposure to groundwater contamination that is present above risk-based remediation levels or MCLs. The remedial investigation for Site 18 indicates that the current condition of the site meets these remedial-action objectives.

4.2.11 General Response Actions for Groundwater

Although available information indicates that the current condition of the site meets remedial-action objectives and remediation is not required, remedial technologies have been identified in conformance with regulatory processes. The general response actions identified for Site 18 groundwater include:

- No action
- Monitoring
- Institutional controls
- Extraction followed by treatment
- Containment

4.2.12 Identification and Screening of Remedial Technologies for Groundwater

Table 4-2 identifies remedial technologies available if groundwater was found to be contaminated at Site 18. The no-action alternative is the only one chosen for development because of the current information that groundwater does not pose a human health or environmental risk at Site 18.

4.2.13 Detailed Analysis of No-Action Alternative for Groundwater

Overall protection of human health and the environment. This alternative meets the remedial-action objectives.

Compliance with ARARs. Drinking water MCLs are being met by this alternative.

Long-term effectiveness and permanence. All available data indicate that the residual risk for this alternative would be protective of human health and the environment over the long term.

Reduction of toxicity, mobility, or volume through treatment. There is no reduction of toxicity, mobility, or volume of groundwater contaminants through treatment under this alternative.

Short-term effectiveness. There are no short-term hazards associated with this alternative.

Implementability. There are no implementability concerns associated with the no-action alternative.

Cost. There are no costs for this alternative.

State acceptance. This criterion will be evaluated following regulatory review of this FS.

Community acceptance. This criterion will be evaluated during the public comment period that will follow release of the RI and FS reports to the community.

5.0 OPERABLE UNIT 7

OU 7 is located in the south-central portion of TEAD-N and consists of one site: the Pole Transformer PCB Spill Site (Site 5) which is the location of a PCB spill that occurred when a transformer was damaged during a utility-pole fire.

5.1 POLE TRANSFORMER PCB SPILL SITE (SITE 5)

5.1.1 Site Description

The Pole Transformer PCB Spill Site (Site 5) is the location of a PCB spill that occurred when a transformer was damaged during a utility pole fire. In 1976, a fire occurred in a pole-mounted electrical transformer. As a result, the transformer, located on pole No. 184 (Figure 5-1), leaked PCB-containing oil from the pole to the surrounding soils. The oil-saturated soils were excavated adjacent to the pole to the north. The excavation measured approximately 5 feet by 5 feet wide and 3 feet deep. Eleven 55-gallon drums of soil were collected from the excavation. A composite sample was collected from the 11 drums and analyzed for PCBs. Subsequently, the drums were properly disposed of off-site. The area of the excavation was not backfilled.

5.1.2 Nature and Extent of Contamination

As part of the initial clean-up activities at Site 5, a composite soil sample from the 11 drums of excavated soil was collected and analyzed for PCBs. This sample contained 3.45 ppm (mg/kg) of PCB 1260. The RI sampling and analysis program characterized the surface and subsurface soils within and immediately surrounding the former excavation to determine if residual contamination is present. The results of the sampling conducted during the RI are presented in Figure 5-2. Residual contamination consists of the PCB Aroclor 1260, which is present in low but detectable concentrations in three (PPS-92-01, PPS-92-02, and PPS-92-04) of the four surface-soil samples and in one of the subsurface soil samples (PPT-92-05) collected in the excavation at Site 5. The concentrations were 0.117 mg/kg, 0.098 mg/kg, 0.052 mg/kg, and 0.331 mg/kg, respectively. PCBs were not detected in subsurface samples collected at depths of up to 5 feet around the perimeter of the excavation. Detectable concentrations of polychlorinated dibenzodioxins (PCDDs) and polychlorinated dibenzofurans (PCDFs) were also present in most of the samples collected. These contaminants were detected in the parts per trillion range (total PCDDs ranged from 2.8E-5 to 3.8E-4 mg/kg; and PCDFs ranged from 8.0E-6 to 8.0E-5 mg/kg).

On the basis of the RI sampling results, it appears that the residual PCB and associated PCDD and PCDF contamination at Site 5 are restricted to very low levels of near-surface contamination. Based on this information, the contaminants of concern for Site 5 are PCB 1260, PCDDs, and PCDFs as shown in Table 5-1.

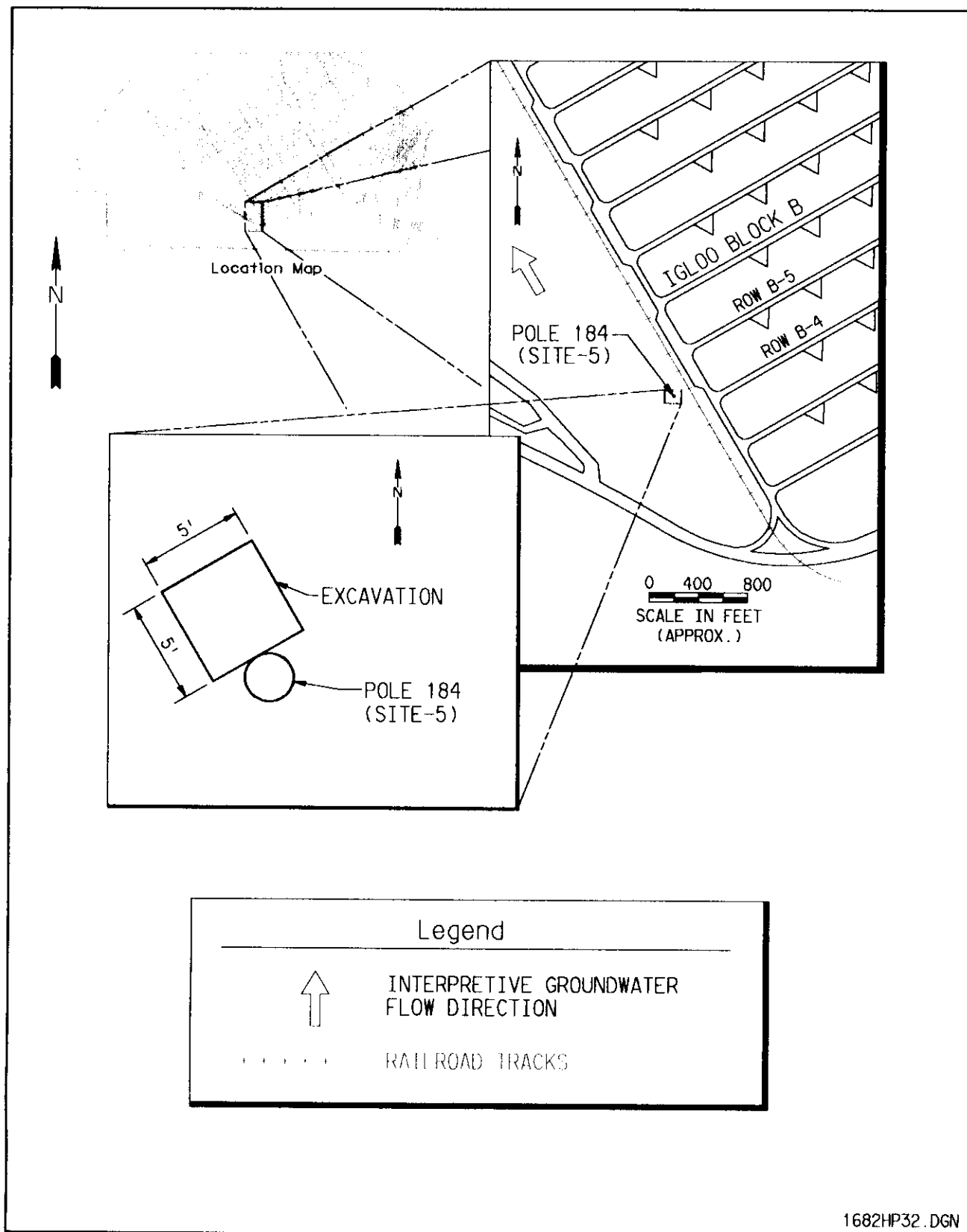


Figure 5-1. Location Map of the Pole Transformer PCB Spill Site (Site 5)

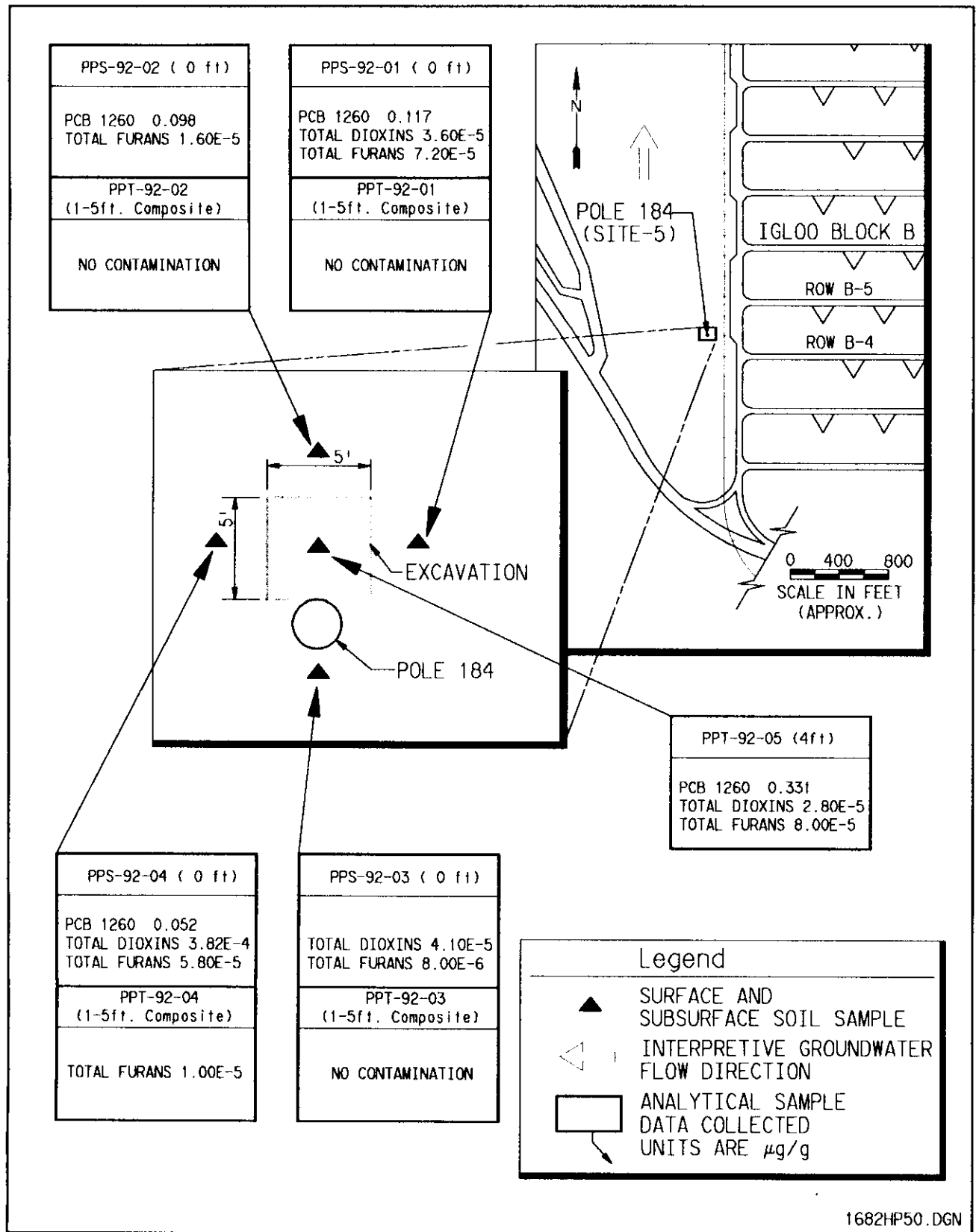


Figure 5-2. RI Sampling and Analysis Results for the Pole Transformer PCB Spill Site (Site 5)

Table 5-1. Contaminants of Concern in Surface and Subsurface Soil at the Pole Transformer PCB Spill Site (Site 5)

Analyte	Total Detects	Total Samples	Low	High	Average	95% Confidence	Statistical Background Concentration	Method	Method Detection Limit
Octachlorodibenzodioxin	1	9	3.0E-4	3.0E-4	3.3E-5	1.3E-4	-- ^(a)	99	3.0E-7
Octachlorodibenzofuran	6	9	2.0E-6	1.0E-5	4.0E-6	7.4E-6	--	99	4.0E-7
2,3,7,8-Tetrachlorodibenzodioxin	1	9	1.5E-5	1.5E-5	1.8E-6	6.4E-6	--	99	2.0E-7
2,3,7,8-Tetrachlorodibenzofuran	3	9	1.0E-6	2.0E-6	4.8E-7	1.1E-6	--	99	1.0E-7
Total Hexachlorodibenzodioxin	3	9	3.0E-6	1.1E-5	2.1E-6	5.5E-6	--	99	3.0E-7
Total Hexachlorodibenzofuran	5	9	1.0E-6	2.4E-5	6.7E-6	1.5E-5	--	99	3.0E-7
Total Heptachlorodibenzodioxin	4	9	1.0E-6	7.2E-5	1.6E-5	3.8E-5	--	99	3.0E-7
Total Heptachlorodibenzofuran	5	9	2.0E-6	1.3E-5	2.4E-6	5.3E-6	--	99	2.0E-7
Total Pentachlorodibenzofuran	4	9	6.0E-6	2.8E-5	9.2E-6	2.1E-5	--	99	3.0E-7
Total Tetrachlorodibenzodioxin	1	9	1.6E-5	1.6E-5	1.9E-6	6.8E-6	--	99	2.0E-7
Total Tetrachlorodibenzofuran	4	9	1.0E-6	1.4E-5	3.4E-6	8.4E-6	--	99	1.0E-7
PCB 1260	3	9	0.098	0.331	0.079	0.173	--	99	0.054

Note.—Concentrations are in µg/g which is equivalent to mg/kg. The average concentration is the average of the detected concentrations. If a contaminant was detected in some samples but not in others, one-half of the sample quantitation limit was used as the concentration value for the non-detects in computing the average value. The 95 % confidence concentration is the 95 % upper confidence limit on the arithmetic average concentration.

^(a)It is assumed that background soil does not contain these organic compounds.

5.1.3 Contaminant Fate and Transport

PCBs strongly adsorb to soils and are resistant to leaching. Leaching of PCBs to the groundwater at Site 5 is highly unlikely because of the depth to groundwater at the site (approximately 300 feet), the low concentrations of PCBs detected in the soil, and the relative immobility of PCBs in soils. In addition, PCB soil cleanup levels based on direct contact assumptions will generally provide sufficient protection of groundwater (EPA, 1990b).

The chemical and environmental stability of PCBs coupled with their strong adherence to soils result in relatively long half-lives especially for the more chlorinated isomers. Although PCBs are highly persistent compounds exhibiting generally low volatilization rates, photolysis and volatilization of PCBs are major removal processes over time. In addition, PCBs may enter the atmosphere through adsorption to airborne particulates with removal occurring through wet and dry deposition. The tendency of PCBs to adsorb to particulates increases as the degree of chlorination increases.

Although PCBs are not appreciably taken up by plants, they do bioconcentrate in tissue because of their stability, high lipid solubility and/or binding, and low water solubility. In addition to the low bioavailability of PCBs in soils, the current physical condition of Site 5 (an approximately 25 square foot, sparsely vegetated area) minimizes the potential for possible bioaccumulation of PCBs in animals.

PCDDs and PCDFs consist of 75 isomers that differ in the number and position of attached chlorine atoms. The most toxic of the PCDD and PCDF isomers is 2,3,7,8-tetrachlorodibenzo-p-dioxin (2,3,7,8-TCDD). PCDDs and PCDFs are usually present as trace impurities in some commercial herbicides, in chlorophenols, and in PCBs. The fate and transport of PCDDs and PCDFs are similar to the fate and transport of PCBs. Most PCDDs and PCDFs are chemically and environmentally stable, relatively insoluble in water, highly persistent, and have long environmental half-lives.

Bioavailability of PCDDs and PCDFs is also similar to the bioavailability of PCBs. Although PCDDs and PCDFs are not appreciably taken up by plants, they do bioconcentrate in tissue because of their stability, high lipid solubility and/or binding, and low water solubility. The highest concentrations of PCDD and PCDF in animals are largely found in the liver and fatty tissue. Considering the physical attributes of Site 5, the potential for bioaccumulation is minimal.

5.1.4 Summary of the Baseline Risk Assessment

The purpose of the BRA is to evaluate potential human health risks associated with the no-action alternative. The initial task of the assessment involves identification of chemicals present at the site that pose a potential risk to human health based on their prevalence and concentration in the environment and inherent toxicity. After potential contaminants of concern are identified, a toxicity assessment is conducted to estimate the relationship between the extent of exposure to a contaminant and the increased likelihood and/or severity of adverse effects. Then, an exposure assessment is performed to evaluate the pathways by

which humans could potentially contact contaminants. The final task consists of determining the magnitude and probability of current and future human health risks associated with the contaminants of concern. This section summarizes the results of the BRA completed as part of the RI for TEAD-N (Rust E&I, 1994). The RI provides additional information on the BRA methodology and results.

5.1.4.1 Human Health Risk Assessment

As more fully discussed in the RI Report for TEAD-N (Rust E&I, 1994), the most likely exposure pathways for contaminants at Site 5 are via dermal contact, incidental soil ingestion, inhalation of fugitive dust, and ingestion of beef derived from cattle potentially exposed to contamination while grazing at TEAD-N. However, fugitive dust emissions from Site 5 are minimal because of its size and the fact that it is lower than the surrounding terrain.

The risk assessment evaluates scenarios for both present land use and future land use conditions. Since there is no construction planned at Site 5, the construction worker scenario can be considered a future case. Residential development in the area of Site 5 is uncertain at this time. However, a future residential land use scenario was evaluated for Site 5.

Under current land use conditions, human receptors include the on-site worker, installation resident, installation school student/employee, and off-site resident from the nearby cities of Tooele, Stockton, and Grantsville. The on-site worker and possible future construction worker are potentially exposed through incidental ingestion of soil, dermal contact, and inhalation of fugitive dust. For the installation resident and off-site residents, inhalation of fugitive dust and consumption of contaminated beef were considered complete, potential exposure pathways. Inhalation of fugitive dust was considered the only complete, potential exposure pathway for the installation school student/employee. Complete pathways for the future on-site residential scenario include all the aforementioned pathways plus homegrown produce consumption.

For the complete exposure pathways discussed above, two exposure cases are analyzed as part of the BRA. The central tendency risk description presented in Table 5-2 is the arithmetic mean risk and is derived by using average exposure values for each pathway/site considered. The RME description presented in Table 5-3 is the high end risk. The RME is estimated by combining upper bound values (either the 95 percent upper confidence limits (UCLs) of the arithmetic mean, or the high concentration if the 95 percent UCL was greater than the highest concentration) so that the result represents an exposure scenario that is both protective and reasonable (EPA, 1991a). Both Tables 5-2 and 5-3 include carcinogenic and noncarcinogenic risk estimates for all complete pathways with the exception of the noncarcinogenic risk estimate for 2,3,7,8-TCDD equivalents.

Guidance from EPA's Reference Dose Work Group indicates that the public health will be protected from noncarcinogenic risk effects resulting from exposure to 2,3,7,8-TCDD as long as the carcinogenic risk is protective of the public health. This is based on the assumption that 2,3,7,8-TCDD does not exhibit a no-effects threshold concentration because of its relatively long biological half-life.

Table 5-2. Summary of Human Health Risk Assessment Results Using Average Exposure Levels for Site 5

Analyte	On-Site Worker ^(a)			Construction Worker ^(b)			Installation School ^(c)			Installation Resident ^(d)			Off-Site Resident ^(e) Tooele			Off-Site Resident ^(e) Stockton			Off-Site Resident ^(e) Grantsville			Future On-Site ^(b) Resident		
	RF ^(a)	HI ^(a)		RF	HI		RF	HI		RF	HI		RF	HI		RF	HI		RF	HI		RF	HI	
<u>Ingestion</u>																								
2,3,7,8-TCDD Equiv.*	3.24E-07			2.06E-08																		1.16E-06		
PCB 1260	6.30E-08	8.18E-04		9.31E-09	1.21E-03																	2.26E-07	1.18E-02	
<u>Inhalation</u>																								
2,3,7,8-TCDD Equiv.	2.94E-11			2.94E-12		3.28E-12			8.79E-12				8.99E-17			1.25E-16			6.86E-17			3.96E-11		
PCB 1260	7.12E-12	9.27E-08		7.12E-13	9.27E-08	7.97E-13	5.19E-08		2.13E-12	1.39E-07			2.18E-17	3.15E-13		3.02E-17	4.37E-13		1.67E-17	2.41E-13		9.59E-12	1.39E-07	
<u>Dermal</u>																								
2,3,7,8-TCDD Equiv.	1.41E-07			8.97E-09																		1.19E-07		
PCB 1260	2.67E-08	3.52E-04		3.95E-09	5.20E-04																	2.25E-08	3.29E-04	
<u>Beef Consumption</u>																								
2,3,7,8-TCDD Equiv.									3.09E-07				1.39E-06			1.39E-06			1.39E-06			1.39E-06		
PCB 1260									6.01E-08	3.90E-03			2.71E-07	3.90E-03		2.71E-07	3.90E-03		2.71E-07	3.90E-03		2.71E-07	3.90E-03	
<u>Vegetable Consumption</u>																								
2,3,7,8-TCDD Equiv.																						4.08E-07		
PCB 1260																						7.93E-08	1.14E-03	
<u>Fruit Consumption</u>																								
2,3,7,8-TCDD Equiv.																						2.29E-07		

Table 5-2. Summary of Human Health Risk Assessment Results Using Average Exposure Levels for Site 5 (continued)

Analyte	On-Site Worker ^(a)		Construction Worker ^(b)		Installation School ^(c)		Installation Resident ^(d)		Off-Site Resident ^(e) Toodle		Off-Site Resident ^(e) Stockton		Off-Site Resident ^(e) Grantsville		Future On-Site ^(f) Resident	
	RF ^g	HI ^h	RF	HI	RF	HI	RF	HI	RF	HI	RF	HI	RF	HI	RF	HI
PCB 1260	5.55E-07	1.17E-03	4.28E-08	1.73E-03	4.08E-12	5.19E-08	3.69E-07	3.90E-03	1.66E-06	3.90E-03	1.66E-06	3.90E-03	1.66E-06	3.90E-03	4.44E-08	6.41E-04
Site Total																

^(a)On-Site Worker is assumed to work at Site 5 10 hours per day 250 days per year for 10 years.

^(b)Construction Worker is assumed to work at Site 5 10 hours per day for 250 days.

^(c)Installation School Students/Employees are assumed to be the school Site 5 hours per day 200 days per year for 2 years.

^(d)Installation Resident is assumed to live on TEAD-N for 2 years.

^(e)Off-Site Residents are assumed to live in the TEAD-N vicinity for 2 years.

^(f)Future On-Site Residents are assumed to live on Site 5 land for 9 years.

^(g)Risk factor.

^(h)Hazard index.

*Risk estimates for polychlorinated dibenzodioxins and polychlorinated dibenzofurans are calculated in terms of 2,3,7,8-TCDD based on toxicity equivalence factors (TEFs).

Table 5-3. Summary of Human Health Risk Assessment Results Using Reasonable Maximum Exposure Levels for Site 5

Analyte	On-Site Worker ^(a)			Construction Worker ^(b)			Installation School ^(c)			Installation Resident ^(d)			Off-Site Resident ^(e) Tooele			Off-Site Resident ^(e) Stockton			Off-Site Resident ^(e) Grantville			Future On-Site ^(e) Resident		
	RF ^(e)	HI ^(e)	RF ^(e)	RF	HI	RF	RF	HI	RF	HI	RF	HI	RF	HI	RF	RF	HI	RF	RF	HI	RF	HI	RF	HI
<u>Ingestion</u>																								
2,3,7,8-TCDD Equiv.*	1.62E-06		1.98E-07																			7.25E-06		
PCB 1260	3.15E-07	1.64E-03	8.94E-08	1.16E-02																		1.41E-06	2.37E-02	
<u>Inhalation</u>																								
2,3,7,8-TCDD Equiv.	7.34E-11		4.41E-12			6.57E-12			1.04E-10				7.52E-16			1.04E-15			5.73E-16				3.30E-10	
PCB 1260	1.78E-11	9.27E-08	1.07E-12	1.40E-07		1.59E-12	5.19E-08		2.52E-11	1.12E-06			1.82E-16	2.54E-12		2.53E-16	3.52E-12		1.39E-16	1.94E-12		8.03E-11	1.12E-06	
<u>Dermal</u>																								
2,3,7,8-TCDD Equiv.	1.76E-06		4.48E-08																			3.73E-06		
PCB 1260	3.34E-07	1.76E-03	1.98E-08	2.60E-03																		7.05E-07	8.07E-03	
<u>Consumption</u>																								
2,3,7,8-TCDD Equiv.							4.30E-06						1.37E-05			1.37E-05			1.37E-05				1.37E-05	
PCB 1260							8.37E-07	3.77E-02	2.66E-06	3.77E-02	2.66E-06	3.77E-02	2.66E-06	3.77E-02	2.66E-06	3.77E-02	2.66E-06	3.77E-02	2.66E-06	3.77E-02	2.66E-06	3.77E-02	2.66E-06	3.77E-02
<u>Vegetable Consumption</u>																								
2,3,7,8-TCDD Equiv.																						3.77E-06		
PCB 1260																						7.33E-07	1.04E-02	
<u>Fruit Consumption</u>																								
2,3,7,8-TCDD Equiv.																							1.98E-06	

Table 5-3. Summary of Human Health Risk Assessment Results Using Reasonable Maximum Exposure Levels for Site 5 (continued)

Analyte	On-Site Worker ^(a)		Construction Worker ^(b)		Installation School ^(c)		Installation Resident ^(d)		Off-Site Resident ^(e) Toole		Off-Site Resident ^(e) Stockton		Off-Site Resident ^(e) Grantsville		Future On-Site ^(f) Resident	
	RF ^(g)	HI ^(h)	RF	HI	RF	HI	RF	HI	RF	HI	RF	HI	RF	HI	RF	HI
PCB 1260	4.03E-06	3.40E-03	3.52E-07	1.42E-02	8.16E-12	5.19E-08	5.14E-06	3.77E-02	1.64E-05	3.77E-02	1.64E-05	3.77E-02	1.64E-05	3.77E-02	3.85E-07	5.45E-03
Site Total																

^(a)On-Site Worker is assumed to work at Site 5 10 hours per day 250 days per year for 25 years.

^(b)Construction Worker is assumed to work at Site 5 10 hours per day for 250 days.

^(c)Installation School Students/Employees are assumed to be at the school site 7 hours per day 200 days per year for 4 years.

^(d)Installation Resident is assumed to live on TEAD-N for 2 years as a child and 7 years as an adult.

^(e)Off-Site Residents are assumed to live in the TEAD-N vicinity for 30 years.

^(f)Future On-Site Residents are assumed to live on Site 5 land for 30 years.

^(g)Risk factor.

^(h)Hazard index.

*Risk estimates for polychlorinated dibenzodioxins and polychlorinated dibenzofurans are calculated in terms of 2,3,7,8-TCDD based on toxicity equivalence factors (TEFs).

At Site 5, all of the chronic, noncarcinogenic risk estimates meet the EPA goal of a residual hazard index of 1 or less. Further, the carcinogenic risk estimates all fall within or below the EPA target range for residual risk of 1E-4 to 1E-6.

5.1.4.2 Ecological Risk Assessment

The ecological risk assessment for Site 5 was qualitative and did not include tissue sampling or bioassays of the vegetation and wildlife. The predominant vegetation consists of sagebrush and wild grasses. Site 5 is small (approximately 5 feet by 5 feet), and the potential wildlife inhabitants would be small and large mammals, birds, and several of the raptor species. Human activity at this site is infrequent. There is no indication that this area is a critical habitat for any endangered or threatened species.

The contaminants of concern at Site 5 are PCBs, PCDDs, and PCDFs. All of these compounds are toxic and bioaccumulate to varying degrees, depending on the pathways. Very little is known about their behavior in the terrestrial environment, their lethal and chronic effects, or their movement up a food chain. This is mainly due to the interspecies differences in sensitivity to these compounds that exist, even in species of biota that are related taxonomically. The compound 2,3,7,8-TCDD (a PCDD) is one of the most toxic contaminants in existence and, because of this, was chosen along with PCB Aroclor as the representative contaminants of concern for the bioaccumulation model used in the ecological risk assessment. The potential exposure pathway used in this model for this site was (1) uptake of the contaminants by vegetation, (2) ingestion of the plants by small mammals, and (3) the consequent off-site ingestion of the small mammals by a raptor. The bioaccumulation model that was used in the risk assessment (proposed by Thomas, 1981; modified by Fordham, 1991) used reproductive failure at the second order consumer level as the benchmark to obtain a TCDD and a PCB soil concentration that represented the lowest level at which reproductive failure would occur due to these particular contaminants. By using conservative maximum acceptable tissue levels and biomagnification factors, the lowest concentrations of TCDD and PCB in the soil that would cause reproductive failure at the second order consumer level were calculated to be above the highest detected levels of TCDD and PCB contamination (see Section 7.0 of the *Final Remedial Investigation Report* (Rust E&I, 1994)).

Because the TCDD and PCB concentrations in the soil were below the reproductive failure value that was established as the benchmark and because the site is extremely small, the overall risk to ecological receptors inhabiting this site, and to the TEAD-N ecosystem as a whole, appears to be minimal. Alterations to the trophic structure and ecological processes at Site 5 and to the TEAD-N facility due to the existing PCB, PCDD, and PCDF contaminants at Site 5 are unlikely.

5.1.5 Remedial-Action Objectives for Soils

The EPA's *Guidance on Remedial Actions for Superfund Sites with PCB Contamination* (EPA, 1990b) recommends that remedial action be considered when PCB levels exceed 1 ppm

(mg/kg) for residential land use and 10 to 25 ppm for industrial land use. The available data for Site 5 indicate that the soil contamination is below the most stringent of these levels. Therefore, the following risk-based remediation levels are the remediation goals for Site 5: (1) limit the cumulative excess cancer risk to human receptors to levels within or below the EPA target range for residual risk of $1\text{E-}4$ to $1\text{E-}6$ and (2) limit the cumulative noncancer hazard index to levels of 1 or less. The remedial-action objectives for Site 5 are to (1) prevent human and environmental (i.e., fauna and flora) exposure to soil contamination that is present at concentrations above risk-based remediation levels and (2) prevent migration of soil contaminants that are present at concentrations above the risk-based remediation levels to off-site receptors or to surface water and groundwater. The Baseline Risk Assessment for Site 5 indicates that the current condition of the site meets the remediation goals.

5.1.6 General Response Actions for Soils

For Site 5, available data indicate that the current condition of the site meets the remediation goals. Therefore, none of the soil requires remediation unless it is decided to remove contaminants in order to reduce excess cancer risks to below the EPA target range ($<1\text{E-}6$). The general response actions that are available for Site 5 are:

- No action
- Institutional controls
- Containment
- In-situ treatment
- Excavation with on-site treatment and disposal
- Excavation with off-site treatment and/or disposal

5.1.7 Identification and Screening of Remedial Technologies for Soils

A variety of remedial technologies are available for potential use at Site 5. Table 5-4 identifies these technologies and screens them according to effectiveness, implementability, and cost. The applicability of each technology depends on factors such as the remediation goals, whether the technology is suitable for PCBs, PCDDs, and/or PCDFs in soil at low concentrations (<1 mg/kg total contaminants), and site characteristics.

As a result of the screening in Table 5-4, the following technologies have been retained for further consideration during the development of remedial alternatives for soils at Site 5:

- No Action
- Institutional Controls
 - Deed Restrictions
 - Fences

Table 5-4. Technology Screening for Soils at the Pole Transformer PCB Spill (Site 5)

Technology	Effectiveness	Implementability	Cost	Screening Results
No Action	Effective because contamination levels are in compliance with ARARs and do not pose an excessive human health or environmental risk.	NA ^(a)	No cost.	Consider. Required for consideration by the NCP ^(b) .
Institutional Controls				
Deed Restrictions	As long as Site 5 is Army property, deed restrictions are not necessary to control the use of the land. Does not reduce contamination.	Readily implementable. ^(c)	Negligible cost.	Consider. Will provide for future public use.
Fences	Long-term enforcement necessary to restrict access to the site. Does not reduce contamination.	Readily implementable.	Low cost. \$25/LF. ^(d)	Consider.
Containment				
Surface Runoff Controls	Does not reduce contamination or prevent exposure of humans, fauna, and flora. Reduces potential for contaminant migration through erosion and leaching. Long-term maintenance and institutional controls necessary.	Readily implementable.	Low cost. Less than or comparable to capping.	Eliminate. Surface water runoff is not a concern at this site.
Capping	Does not reduce contamination. Prevents exposure of humans, fauna, and flora. Prevents erosion and infiltration of water. Long term maintenance and institutional controls necessary.	Readily implementable.	Low cost. \$10 to \$70/SY. ^(e)	Consider.

Table 5-4. Technology Screening for Soils at the Pole Transformer PCB Spill (Site 5) (continued)

Technology	Effectiveness	Implementability	Cost	Screening Results
In situ Treatment				
Biodegradation	Provides contaminant destruction. However, PCDDs and PCDFs are resistant to biodegradation, and PCB concentrations are too low to establish an effective microbial population.	NA	NA	Eliminate. Biodegradation would not be effective at this site.
Radio Frequency Heating	Process extracts contaminants through enhanced volatilization. Laboratory research is limited to soil with much higher PCB concentrations (> 1,000 mg/kg). The driving force for volatilization is very low when contaminant levels are very small (< 1 mg/kg at Site 5).	Process is at the laboratory research and field demonstration stages of development.	Moderate to high cost because of energy use.	Eliminate. Contaminant concentrations are too low at Site 5 for this process to be effective.
Soil Vapor Extraction	Process extracts volatile organic contaminants from soil. There are no volatile contaminants of concern at Site 5.	NA	NA	Eliminate. Not appropriate for PCBs and PCDDs/PCDFs.
Stabilization	Creates a solid monolith that is resistant to leaching. Does not reduce contaminant toxicity or volume. Can be used for organic contaminants when concentrations are low, generally less than 20% by weight.	Readily implementable.	Low cost. \$30+ /ton	Consider.

Table 5-4. Technology Screening for Soils at the Pole Transformer PCB Spill (Site 5) (continued)

Technology	Effectiveness	Implementability	Cost	Screening Results
Vitrification	Creates a solid, glassy monolith that is highly resistant to leaching. Reduces contaminant volume but does not reduce toxicity. Primarily intended for treatment of soils that are contaminated with radionuclides and metals.	Not practical to implement because PCB and PCDD/PCDF concentrations are so low (< 1 mg/kg). Only one vendor is available.	High cost due to high energy consumption.	Eliminate. Contaminant concentrations are too low for this process to be practical.
Excavation with On-Site Treatment and Disposal				
Biological Treatment	Provides destruction of biodegradable organic contaminants. However, PCDDs and PCDFs are resistant to biodegradation, and PCB concentrations are too low to establish an effective microbial population.	NA	NA	Eliminate. Biological treatment would not be effective at this site.
Chemical Extraction	Process extracts organic contaminants. Secondary treatment is necessary to reduce toxicity and mobility of the recovered contaminants. Contaminant concentrations at Site 5 are too low for this process to be effective.	Process is still largely at the pilot scale and demonstration stages of development. Few treatment units are available.	High cost. \$100 to \$500/ton.	Eliminate. Contaminant concentrations are too low for the process to be effective.
Dechlorination	Process extracts and detoxifies chlorinated aromatic organics, including PCBs and PCDDs/PCDFs. Contaminant concentrations at Site 5 are too low for this process to be effective.	For treatment of soils, process is still largely at the pilot scale and demonstration stages of development.	Cost data are not available.	Eliminate. Contaminant concentrations are too low for the process to be effective.

Table 5-4. Technology Screening for Soils at the Pole Transformer PCB Spill (Site 5) (continued)

Technology	Effectiveness	Implementability	Cost	Screening Results
Incineration	Provides thermal destruction of organic contaminants.	Incineration of PCBs and PCDDs/PCDFs requires stringent testing and trial burns. A shortage of incinerator availability exists.	High cost. \$300 to \$600/ton.	Eliminate. Not feasible because of shortage of incinerator availability.
Physical Separation	Reduces contaminant volume by separating out the fine-grained materials (assuming contaminants are adsorbed to silts and clays). Contaminant concentrations are too low for effective treatment (< 1 mg/kg total contaminants).	Readily implementable.	Low to moderate cost. Less than or comparable to soil washing.	Eliminate. Contaminant concentrations are too low for effective treatment.
Soil Washing	Reduces contaminant volume by separating out the fine-grained materials (assuming contaminants are adsorbed to silts and clays). Generates wastewater that may require treatment. Contaminant concentrations are too low for effective treatment (< 1 mg/kg total contaminants).	Readily implementable.	Moderate cost. \$40 to \$50/ton.	Eliminate. Contaminant concentrations are too low for effective treatment.
Stabilization	Creates a solid monolith that is resistant to leaching. Does not reduce contaminant toxicity or volume. Stabilization can be used for organic contaminants when concentrations are low, generally less than 20% by weight.	Readily implementable.	Low to high cost. \$30 to \$250/ton.	Consider.

Table 5-4. Technology Screening for Soils at the Pole Transformer PCB Spill (Site 5) (continued)

Technology	Effectiveness	Implementability	Cost	Screening Results
Thermal Desorption	Extracts organic contaminants through enhanced volatilization. Secondary treatment is necessary to reduce toxicity and mobility of extracted contaminants.	A shortage in thermal desorption capacity exists.	High cost. \$300 to \$800/ton.	Eliminate. Not feasible because of shortage of equipment availability. Not practical because of low contaminant concentrations (<1 mg/kg).
Volatilization	Process extracts volatile organic contaminants from soil. Not appropriate for Site 5 because there are no volatile contaminants.	NA	NA	Eliminate.
Excavation and Off-Site Treatment and/or Disposal				
Incineration	Process provides destruction of organic contaminants.	Less feasible for soils with less than 50 mg/kg PCBs.	High cost. \$900 to \$4,200/ton.	Consider.
Landfilling	Removes contaminated soil from the site and eliminates the need for long-term management of the site. Safe excavation and transport are short-term concerns. Long-term effectiveness depends on pretreatment and disposal practices at the receiving facility.	Readily implementable.	Moderate to high cost. \$100 to \$250/ton.	Consider.

^aNA = Not applicable.

^bNCP = National Contingency Plan.

^cReadily implementable technologies are those for which services or vendors are available.

^dLF = Linear foot.

^eSY = Square yard.

^fCY = Cubic yard.

- Containment
 - Capping
- In Situ Treatment
 - Stabilization
- Excavation Followed by On-Site Treatment and Disposal
 - Stabilization
- Excavation Followed by Off-Site Treatment and/or Disposal
 - Landfill Disposal
 - Incineration

5.1.8 Development of Remedial Alternatives for Soils

Available data indicate that the soils at the site:

- Contain insufficient PCBs to require remedial action per EPA guidance (EPA, 1990b)
 - For residential land use, the PCB action level is 1 ppm (mg/kg); for industrial land use, the PCB action level ranges from 10 ppm to 25 ppm.
- Qualify as clean under TSCA
 - Existing soil qualifies as clean soil (having less than 1 mg/kg PCBs) under TSCA.
- Contain insufficient PCBs to create a human health or environmental risk exceeding EPA guidelines
 - Carcinogenic risk within or below 1E-4 to 1E-6.
 - Noncarcinogenic risk hazard indices all below 1.

ARARs have been screened from the documents in Appendix A and Table 1-1. Table 5-5 summarizes ARAR choices for Site 5. They are analyzed further in Section 5.1.9.

Six remedial alternatives are being considered for this site:

Alternative 1: No Action. Site soil would remain in place.

Alternative 2: Institutional Controls. This alternative does not involve active remediation; site soils would be left in place. However, this alternative would limit the potential for human and fauna exposure to site contaminants by placing controls on access to the site. These controls would include fences or other barriers, warning signs, and regular surveillance. Deed restrictions would be developed for future protection in the event the property were released to the public.

Table 5-5. Compliance of Alternatives with ARARs for Site 5

Statute	Alternative 1: No Action		Alternative 2: Institutional Controls		Alternative 3: Soil Cover		Alternative 4: Stabilization		Alternative 5: TSCA Approved Landfill Disposal		Alternative 6: Incineration	
	Meets Sds.	Does Not Meet Sds.	Meets Sds.	Does Not Meet Sds.	Meets Sds.	Does Not Meet Sds.	Meets Sds.	Does Not Meet Sds.	Meets Sds.	Does Not Meet Sds.	Meets Sds.	Does Not Meet Sds.
TSCA-Soils	X		X		X		X		X		X	
EPA PCB Guidance-Soils	X*		X*		X*		X*		X*		X*	
OSHA	NA		X		X		X		X		X	
Utah Air Conservation Act	NA		NA		X**		X**		X**		X**	
Utah Solid & Hazardous Waste Act	NA		NA		NA		NA		X		X	
Utah Solid Waste Mgmt. Act	NA		NA		NA		NA		X		X	
Safe Drinking Water Act (MCLs)	X		X		X		X		X		X	
40 CFR Part 268 Landfill Disposal	NA		NA		NA		NA		NA		X	
Utah Groundwater Protection Rule	X		X		X		X		X		X	
Utah Safe Drinking Water Act (MCLs)	X		X		X		X		X		X	
Hazardous Materials Transport Act	NA		NA		NA		NA		X		X	

*=to be considered (TBC)

**=action-specific, would apply during cleanup

NA=not applicable

Alternative 3: Soil Cover. This alternative involves filling the excavation hole and placing a 10-inch-thick clean soil cover over the site. A 10-foot-by-10-foot area was chosen for remediation. This conservatively covers the known areas of contamination. This alternative does not involve active remediation; site soils would be left in place beneath the cover. However, this alternative would reduce the potential for human and fauna exposure to site contaminants by placing a soil cover over the site.

Alternative 4: Stabilization. This alternative involves mixing the contaminated soil with a solidifying agent such as cement. Hardening of the solidifying agent binds and reduces the mobility of the soil contaminants. Stabilization can either be done in-situ or in an external mixing vessel. There would be an overall volume increase. The soils would be left in place, but relatively immobilized.

Alternative 5: Landfill Disposal. This alternative involves excavation of contaminated soil and hauling to a TSCA-approved disposal site. Clean soil from TEAD-N would be used to backfill the excavation. For Site 5, a volume of 20 cubic yards (10 feet by 10 feet by 6 feet deep minus the volume of the existing excavation) was used for remediation estimate purposes.

Alternative 6: Incineration. This alternative involves excavation of 20 cubic yards of potentially contaminated soil and hauling it to a TSCA-approved site for incineration. Clean soil from TEAD-N would be used to backfill the excavation.

5.1.9 Detailed Analysis of Alternatives for Soils

5.1.9.1 *Alternative 1: No Action*

Overall protection of human health and the environment. This alternative meets the remedial-action objectives.

Compliance with ARARs. Soils at this site meet the TSCA standard and the TBC EPA guidance for clean soil of less than 1 mg/kg PCBs.

Long-term effectiveness and permanence. The BRA indicates that the residual risk for this alternative would meet the remediation goals of limiting the cumulative excess cancer risk to human receptors to levels within or below the EPA target range for residual risk of 1E-4 to 1E-6 and limiting the cumulative noncancer hazard index to levels of 1 or less. The qualitative ecological risk assessment also indicates that potential risk to ecological receptors would be low. As a result, this site presents no long-term risks to human health and the environment.

Reduction of toxicity, mobility, or volume through treatment. There is no reduction of the toxicity, mobility, or volume of soil contaminants through treatment under this alternative.

Short-term effectiveness. There are no short-term hazards to human health or the environment.

Implementability. There are no implementability concerns for the no-action alternative.

Cost. There are no costs for the no-action alternative.

State acceptance. This criterion will be evaluated following regulatory review of this FS.

Community acceptance. This criterion will be evaluated during the public comment period that will follow release of the RI and FS reports to the community.

5.1.9.2 Alternative 2: Institutional Controls

Overall protection of human health and the environment. This alternative meets the remedial-action objectives.

Compliance with ARARs. EPA guidance and TSCA standards of less than 1 mg/kg PCB for clean soils would be met. This alternative would also comply with OSHA requirements for worker health and safety during construction activities. Federal and State drinking water MCLs are met by this alternative.

Long-term effectiveness and permanence. The BRA indicates that the residual risk for this alternative would meet the remediation goals of limiting the cumulative excess cancer risk to human receptors to levels within or below the EPA target range for residual risk of $1\text{E-}4$ to $1\text{E-}6$ and limiting the cumulative noncancer hazard index to levels of 1 or less. By using fences or other access restrictions to reduce the amount of time that on-site workers are allowed on the site, institutional controls could exceed the remediation goals by further reducing the residual excess cancer risk to on-site workers. Deed restriction would provide for future protection in the event of release of the property to the public. Long-term enforcement of the institutional controls would be necessary to exceed the remediation goals, but would not be necessary to meet these goals. The qualitative ecological risk assessment also indicates that the potential risk to ecological receptors would be low. The installation of a barrier is not expected to impact the environment because this site is very small.

Reduction of toxicity, mobility, or volume through treatment. There is no reduction of the toxicity, mobility, or volume of soil contaminants through treatment under this alternative.

Short-term effectiveness. Human health concerns associated with the implementation of this alternative are limited to the construction hazards to personnel that would be involved with the installation of a fence or other barrier at the site. The implementation time would be sufficiently short (less than 1 week), so that the health risk due to potential exposure to site contaminants would be negligible. Wildlife may be temporarily disturbed by the construction activities.

Implementability. Institutional controls involve simple activities such as the installation of fences and surveillance. Obtaining deed restrictions for future use would be a straight forward, well-proven process. This alternative is, therefore, readily implementable.

Cost. The costs to install and maintain a chain link fence around the perimeter of Site 5 are summarized below and detailed in Appendix B.

Capital: \$3,800

Annual O&M Costs: \$400

Present Worth of O&M at 5%: \$6,200

Total Capital and Present Worth: \$10,000

The cost of obtaining deed restrictions assumes the use of existing staff and is negligible.

State acceptance. This criterion will be evaluated following regulatory review of this FS.

Community acceptance. This criterion will be evaluated during the public comment period that will follow release of the RI and FS reports to the community.

5.1.9.3 Alternative 3: Soil Cover

Overall protection of human health and the environment. This alternative meets the remedial-action objectives.

Compliance with ARARs. This alternative meets the EPA guidance and the TSCA standard for clean soil of less than 1 mg/kg PCBs. This alternative would also comply with OSHA requirements for worker health and safety during the installation of the soil cover. The Utah Air Conservation Act would be the action-specific ARAR to regulate fugitive dust and particulates. Federal and Utah drinking water MCLs are met by this alternative.

Long-term effectiveness and permanence. The Baseline Risk Assessment indicates that the residual risk for this alternative would meet the remediation goals of limiting the cumulative excess cancer risk to human receptors to levels within or below the EPA target range for residual risk of 1E-4 to 1E-6 and limiting the cumulative noncancer hazard index to levels of 1 or less. By placing a clean soil cover on the site, this alternative could exceed the remediation goals by further reducing the residual excess cancer risk to on-site workers, current on-site residents, and current off-site residents. The qualitative ecological risk assessment also indicates that the potential risk to ecological receptors would be low. The installation of a soil cover is not expected to impact the environment.

Reduction of toxicity, mobility, or volume through treatment. There is no reduction of the toxicity or volume of soil contaminants through treatment under this alternative. Mobility of windblown soil which may contain adsorbed PCBs would be reduced by this alternative.

Short-term effectiveness. Human health concerns associated with the implementation of this alternative are limited to the construction hazards to personnel involved with the installation of the soil cover at the site. The implementation time would be sufficiently short (less than 1 week), so that the health risk due to potential exposure to site contaminants would be negligible. Wildlife may be temporarily disturbed by the construction activities.

Implementability. The placement of a soil cover over the site involves simple construction activities. Contractors are readily available, so this alternative is readily implementable.

Cost. The costs to install a soil cover over Site 5 are summarized below and detailed in Appendix B.

Capital: \$850

Annual O&M: \$0

Present Worth of O&M at 5%: \$0

Total Capital and Present Worth: \$850

State acceptance. This criterion will be evaluated following regulatory review of this FS.

Community acceptance. This criterion will be evaluated during the public comment period that will follow release of the RI and FS reports to the community.

5.1.9.4 *Alternative 4: Stabilization*

Overall protection of human health and the environment. This alternative meets the remedial action objectives.

Compliance with ARARs. This alternative meets the EPA guidance and TSCA PCB standard for clean soil of less than 1 mg/kg PCBs. It would greatly reduce the possibility of migration of soil contaminants to off-site receptors. This alternative would also comply with OSHA requirements for worker health and safety during stabilization. The Utah Air Conservation Act would be the action-specific ARAR to regulate fugitive dust and particulates. Federal and state drinking water MCLs would be met by this alternative.

Long-term effectiveness and permanence. By stabilizing the soils on the site, this alternative would reduce contaminant migration and potential for human or fauna contact for many years. There should be no long-term maintenance required.

Reduction of toxicity, mobility, or volume through treatment. There is no reduction of toxicity under this alternative. Mobility of soil contaminants is significantly reduced. There would be an increase in volume due to addition of the solidifying agent to the contaminated soil.

Short-term effectiveness. Human health concerns resulting from the implementation of this alternative are limited to construction hazards to personnel involved with the stabilization process. Implementation time would be less than 1 month, so that the health risk due to exposure to contaminants would be negligible. Wildlife may be temporarily disrupted by the stabilization activities.

Implementability. Stabilization involves proven, readily available technology, so this alternative is readily implementable.

Cost. The costs to stabilize a 10-foot by 10-foot by 6-foot-deep site are summarized below and presented in more detail in Appendix B.

Capital: \$2,700

Annual O&M: \$0

Present Worth of O&M at 5%: \$0

Total Capital and Present Worth: \$2,700

State Acceptance. This criterion will be evaluated following regulatory review of this FS.

Community Acceptance. This criterion will be evaluated during the public comment period that will follow release of the RI and FS reports to the community.

5.1.9.5 Alternative 5: Landfill Disposal

Overall protection of human health and the environment. Since all contamination is removed from the site to a regulated landfill, this alternative meets the remedial action objectives.

Compliance with ARARs. This alternative meets the EPA guidance and TSCA PCB standard for clean soil of less than 1 mg/kg PCBs. This alternative would also comply with OSHA requirements for worker health and safety during soil handling. The Utah Air Conservation Act would be the action-specific ARAR to regulate fugitive dust and particulates. The Utah Solid and Hazardous Waste Act (19-6-01), Utah Solid Waste Management Act, 40 CFR Part 268 Landfill Disposal Regulations, Hazardous Materials Transport Act, and state and federal MCLs would also be ARARs.

Long-term effectiveness and permanence. Since all contaminants are removed from the site, this alternative would be a permanent solution as regards TEAD-N. However, the contaminants would still exist but in a controlled landfill site designed to permanently protect human health and the environment.

Reduction of toxicity, mobility, or volume through treatment. The strategy chosen for this alternative would eliminate the contaminant toxicity, mobility, and volume from the site, but the waste load of the landfill would be increased so that there is no reduction of toxicity, mobility, or volume through treatment under this alternative.

Short-term effectiveness. Human health concerns resulting from the implementation of this alternative are limited to construction hazards for personnel. Implementation time would be short, so that the health risk due to exposure to PCB would be negligible. Dust control during excavation, hauling, and backfill operations would contain particulate emissions. Wildlife may be temporarily disrupted by the construction activity.

Implementability. Contractors and appropriate equipment are readily available for this construction work.

Cost. The costs to implement this alternative are summarized below and presented in more detail in Appendix B.

Capital: \$2,600

Annual O&M: \$0

Present Worth of O&M @ 5%: \$0

Total Capital and Present Worth: \$2,600

State Acceptance. This criterion will be evaluated following regulatory review of this FS.

Community Acceptance. This criterion will be evaluated during the public comment period that will follow release of the RI and FS reports to the community.

5.1.9.6 Alternative 6: Incineration

Overall protection of human health and the environment. Essentially all of the PCB contamination would be permanently destroyed by incineration so that the remedial action objective would be exceeded.

Compliance with ARARs. This alternative meets the EPA guidance and TSCA PCB standards for clean soil of less than 1 mg/kg PCBs. This alternative would also comply with OSHA requirements for worker health and safety during soil handling. The Utah Air Conservation Act would be the action-specific ARAR to regulate fugitive dust and particulates. The Utah Solid and Hazardous Waste Act (19-6-01) Utah Solid Waste Management Act, 40 CFR Part 268 Landfill Disposal regulations, Hazardous Materials Transport Act, and State and Federal MCLs would also be ARARs.

Long term effectiveness and permanence. Essentially all of the PCBs would be permanently destroyed by incineration.

Reduction of toxicity, mobility, or volume through treatment. The toxicity, mobility, and volume of the PCBs would be effectively eliminated by incineration. The volume of incinerator ash to be disposed would be essentially the same as the original soil volume.

Short-term effectiveness. Human health concerns resulting from the implementation of this alternative are limited to construction hazards to personnel. Implementation time would be short, so that the health risk due to exposure to PCB would be negligible. Dust control during excavation, hauling, and backfill operations would contain particulate emissions. Wildlife may be temporarily disrupted by the construction activity.

Implementability. Contractors and equipment are readily available to excavate, backfill, and haul the soils. A TSCA-permitted incinerator is available in the Tooele area. Further characterization and perhaps batch testing of incineration may be required because of the very low concentration of PCBs in Site 5 soil.

Cost. The costs to remove and incinerate 20 cubic yards of soil plus backfill the excavation are summarized below and presented in more detail in Appendix B.

Capital: \$41,000

Annual O&M: \$0

Present Worth of O&M at 5%: \$0

Total Capital and Present Worth: \$41,000

State Acceptance. This criterion will be evaluated following regulatory review of this FS.

Community Acceptance. This criterion will be evaluated during the public comment period that will follow release of the RI and FS to the community.

5.1.10 Comparative Analysis for Soils

Table 5-6 provides a comparative analysis of Alternatives 1 through 6 for Site 5.

5.1.11 Remedial-Action Objectives for Groundwater

The only potential route of exposure from contaminated groundwater is via existing or future downgradient wells. A potential may exist for contamination of the groundwater through leaching of the soil by infiltration of precipitation. However, because PCBs tend to adsorb strongly to soils, thus minimizing leaching, and because the estimated depth to groundwater below Site 5 is over 300 feet, it is unlikely that groundwater contamination would occur.

The groundwater remedial action objective for Site 5 would be to reduce contaminant levels to below MCLs. This could be met through source control and/or remediation. Meeting this objective reduces risk to human health to acceptable levels and maintains the quality of water for future use. Further, EPA guidance (EPA, 1990b) states that adequate protection of groundwater is generally provided if soil PCB levels meet the stated guidelines (i.e., < 1 ppm PCBs). All available data indicate that the current condition of the site meets the objective.

5.1.12 General Response Action for Groundwater

Although available information indicates that the current condition of Site 5 meets the remedial-action objective and remediation is not required, remedial technologies have been identified in conformance with regulatory processes. These response actions include:

Table 5-6. Comparative Analysis of Remedial Alternatives for Site 5 Soils

Criterion	Alternative 1: No Action	Alternative 2: Institutional Controls	Alternative 3: Soil Cover	Alternative 4: Stabilization	Alternative 5: Landfill Disposal	Alternative 6: Incineration
Overall Protection	Meets the remedial-action objectives of protecting human health and the environment.	Meets the remedial-action objectives of protecting human health and the environment.	Meets the remedial-action objectives of protecting human health and the environment.	Meets the remedial-action objectives of protecting human health and the environment.	Meets the remedial-action objectives of protecting human health and the environment.	Meets the remedial-action objectives of protecting human health and the environment.
Compliance with ARARs ^(a)	Also meets the TSCA ^(a) and EPA standards for a clean soil of less than 1 mg/kg PCBs. Meets SDWA MCLs.	Also meets the TSCA and EPA standards for a clean soil of less than 1 mg/kg PCBs. Would meet OSHA ^(a) requirements for worker health and safety during implementation. Meets SDWA MCLs.	Also meets the TSCA and EPA standards for a clean soil of less than 1 mg/kg PCBs. Would meet OSHA requirements for worker health and safety during implementation. Meets SDWA MCLs.	Also meets the TSCA and EPA standards for a clean soil of less than 1 mg/kg PCBs. Would meet OSHA requirements for worker health and safety during implementation. Meets SDWA MCLs.	Also meets the TSCA and EPA standards for a clean soil of less than 1 mg/kg PCBs. Would meet OSHA requirements for worker health and safety during implementation. Also meets State and Federal Land Disposal and Hazardous Waste Handling regulations. Meets SDWA MCLs.	Also meets the TSCA and EPA standards for a clean soil of less than 1 mg/kg PCBs. Would meet OSHA requirements for worker health and safety during implementation. Also meets State and Federal Land Disposal and Hazardous Waste Handling regulations. Meets SDWA MCLs.
Long-Term Effectiveness	Would meet the remediation goals of limiting the cumulative excess cancer risk to human receptors to levels within or below the EPA target range for residual risk of 1E-4 to 1E-6 and limiting the cumulative noncancer hazard index to levels of 1 or less. The qualitative risk to ecological receptors would be low.	Would meet the remediation goals of limiting the cumulative excess cancer risk to human receptors to levels within or below the EPA target range for residual risk of 1E-4 to 1E-6 and limiting the cumulative noncancer hazard index to levels of 1 or less. The qualitative risk to ecological receptors would be low.	Would meet the remediation goals of limiting the cumulative excess cancer risk to human receptors to levels within or below the EPA target range for residual risk of 1E-4 to 1E-6 and limiting the cumulative noncancer hazard index to levels of 1 or less. The qualitative risk to ecological receptors would be low.	Would meet the remediation goals of limiting the cumulative excess cancer risk to human receptors to levels within or below the EPA target range for residual risk of 1E-4 to 1E-6 and limiting the cumulative noncancer hazard index to levels of 1 or less. The qualitative risk to ecological receptors would be low.	Would meet the remediation goals of limiting the cumulative excess cancer risk to human receptors to levels within or below the EPA target range for residual risk of 1E-4 to 1E-6 and limiting the cumulative noncancer hazard index to levels of 1 or less. The qualitative risk to ecological receptors would be low.	Would meet the remediation goals of limiting the cumulative excess cancer risk to human receptors to levels within or below the EPA target range for residual risk of 1E-4 to 1E-6 and limiting the cumulative noncancer hazard index to levels of 1 or less. The qualitative risk to ecological receptors would be low.
Reduction of Toxicity, Mobility, and Volume	There is no reduction of the toxicity, mobility, or volume of soil contaminants through treatment under this alternative.	There is no reduction of the toxicity, mobility, or volume of soil contaminants through treatment under this alternative.	There is no reduction of the toxicity, mobility, or volume of soil contaminants through treatment under this alternative.	There is no reduction of the toxicity, mobility, or volume of soil contaminants through treatment under this alternative. There is an overall increase in volume due to the addition of solidifying agent.	There is no reduction of the toxicity, mobility, or volume of soil contaminants through treatment under this alternative.	Toxicity and mobility of contamination are permanently removed by this alternative. Waste volume is unchanged.

Table 5-6. Comparative Analysis of Remedial Alternatives for Site 5 Soils (continued)

Criterion	Alternative 1: No Action	Alternative 2: Institutional Controls	Alternative 3: Soil Cover	Alternative 4: Stabilization	Alternative 5: Landfill Disposal	Alternative 6: Incineration
Short-Term Effectiveness	There are no short-term hazards to human health or the environment associated with this alternative.	Health concerns are the construction hazards associated with installation of a fence or other barrier. No disruption of wildlife is expected.	Health concerns are the construction hazards associated with installation of the soil cover. Temporary disruption of wildlife may occur during construction.	Health concerns are the construction hazards associated with the stabilization process. Temporary disruption of wildlife may occur during stabilization.	Health concerns are the construction hazards associated with the soil removal, haulage, and backfill. Temporary disruption of wildlife may occur during construction.	Health concerns are the construction hazards associated with the soil removal, haulage, and backfill. Temporary disruption of wildlife may occur during construction.
Implementability	There are no implementability concerns.	Readily implementable.	Readily implementable.	Readily implementable.	Readily implementable.	Readily implementable.
Cost	No cost.	Capital: \$3,800 O&M/yr: \$400 PW ^(a) @ 5%: \$6,200 Total: \$10,000	Capital: \$850 O&M/yr: 0 PW @ 5%: 0 Total: \$850	Capital: \$2,700 O&M/yr: 0 PW @ 5%: 0 Total: \$2,700	Capital: \$2,600 O&M/yr: 0 PW @ 5%: 0 Total: \$2,600	Capital: \$41,000 O&M/yr: 0 PW @ 5%: 0 Total: \$41,000
State Acceptance	To be evaluated following regulatory review of this FS.	To be evaluated following regulatory review of this FS.	To be evaluated following regulatory review of this FS.	To be evaluated following regulatory review of this FS.	To be evaluated following regulatory review of this FS.	To be evaluated following regulatory review of this FS.
Community Acceptance	To be evaluated during the public comment period that will follow release of the RI and FS reports to the community.	To be evaluated during the public comment period that will follow release of the RI and FS reports to the community.	To be evaluated during the public comment period that will follow release of the RI and FS reports to the community.	To be evaluated during the public comment period that will follow release of the RI and FS reports to the community.	To be evaluated during the public comment period that will follow release of the RI and FS reports to the community.	To be evaluated during the public comment period that will follow release of the RI and FS reports to the community.

*ARARs=Applicable or Relevant and Appropriate Requirements.

^bTSCA = Toxic Substances Control Act.

^cOSHA = Occupational Safety and Health Act.

^dO&M/yr=operation and maintenance/year.

^ePW=present worth.

- No action
- Monitoring
- Institutional controls
- Extraction followed by treatment

Because of the indicated conclusion that the remedial-action objective is currently being met, the no-action alternative is the only one chosen for development.

5.1.13 Detailed Analysis of No-Action Alternative for Groundwater

Overall protection of human health and the environment. This alternative meets the remedial-action objective.

Compliance with ARARs. All available well data indicate that drinking water MCLs for PCB are met by this alternative.

Long-term effectiveness and permanence. All available data indicate that the residual risk for this alternative would be protective of human health and the environment over the long term.

Reduction of toxicity, mobility, or volume through treatment. There is no reduction of toxicity, mobility, or volume of groundwater contaminants through treatment under this alternative.

Short-term effectiveness. There are no short-term hazards associated with this alternative.

Implementability. There are no implementability concerns associated with the no-action alternative.

Cost. There are no costs for this alternative.

State acceptance. This criterion will be evaluated following regulatory review of this FS.

Community acceptance. This criterion will be evaluated during the public comment period that will follow release of the RI and FS reports to the community.

6.0 OPERABLE UNIT 10

6.1 BOX ELDER WASH DRUM SITE (SITE 41)

6.1.1 Site Description

OU 10 consists of the Box Elder Wash Drum Site (Site 41), located southeast of Row J of the Igloo Storage Area (Figure 6-1). The site contains 21 drums in the Box Elder Wash streambed, which carries intermittent runoff from the southwestern corner of TEAD-N, north through the Igloo Storage Area, and across the north-central TEAD-N boundary.

The drums in the streambed were apparently dumped off the eastern edge and lie in the lower bank and bottom of the wash. The drums are present in a 200-foot-long stretch of the wash, and most of the drums are at least partially obscured by soil and/or vegetation. The soil cover on the drums appears to have resulted from sedimentation during periods of surface-water flow and from caving of the steep stream bank. The drums are in various stages of deterioration and have no obvious markings. The drums contain a black tarry substance that resembles roofing tar. There are small areas of stained soil associated with the drums and one area of a surface tar spill above the wash channel.

6.1.2 Nature and Extent of Contamination

In April of 1989, the Environmental Management Office (EMO) of TEAD collected solid samples of a black tarry substance from four of the open drums at Site 41. The samples were analyzed for VOCs, semi-VOCs, and inorganics. Benzene, phenanthrenes, unidentified aliphatic and polycyclic aliphatic hydrocarbons, barium, and mercury were detected in these samples. Rust E&I's RI activities included a geophysical survey to determine the potential location(s) of buried drums in the Box Elder Wash channel, hand excavation of buried or partially buried barrels for sampling, resampling of previously sampled drums, sampling of soils surrounding the drums (surface and subsurface), sampling of soils downstream of the drum site, and the collecting of a sample at the surface tar spill above the wash. The RI samples were analyzed for VOCs, semi-VOCs, explosives, metals, and anions. Figure 6-1 shows the location of Site 41, and Figure 6-2 shows the distribution of contaminants which were detected in soil samples and samples of the drum contents. Table 6-1 lists the contaminants of concern in soils and range of detected concentrations for the drums at Site 41. The contaminant of concern in soil is pyrene. Pyrene was detected in 1 sample out of 13, at a location downstream from the drums, at a concentration of 0.990 $\mu\text{g/g}$. Several contaminants were detected in the tarry content of the drums, including the volatile organics 1,2 dimethylbenzene, 1,3 dimethylbenzene, acetone, ethylbenzene, methyl ethyl ketone, methyl-N-butyl ketone, toluene, and benzene; the explosives HMX and nitrobenzene; the metals barium, beryllium, cadmium, chromium, copper, iron, lead, nickel, silver, and zinc; and the anions chloride, fluoride, nitrate, nitrite, phosphate, and sulfate. The sample of the spilled tar above the wash (BES-92-09) contained an elevated level of nickel.

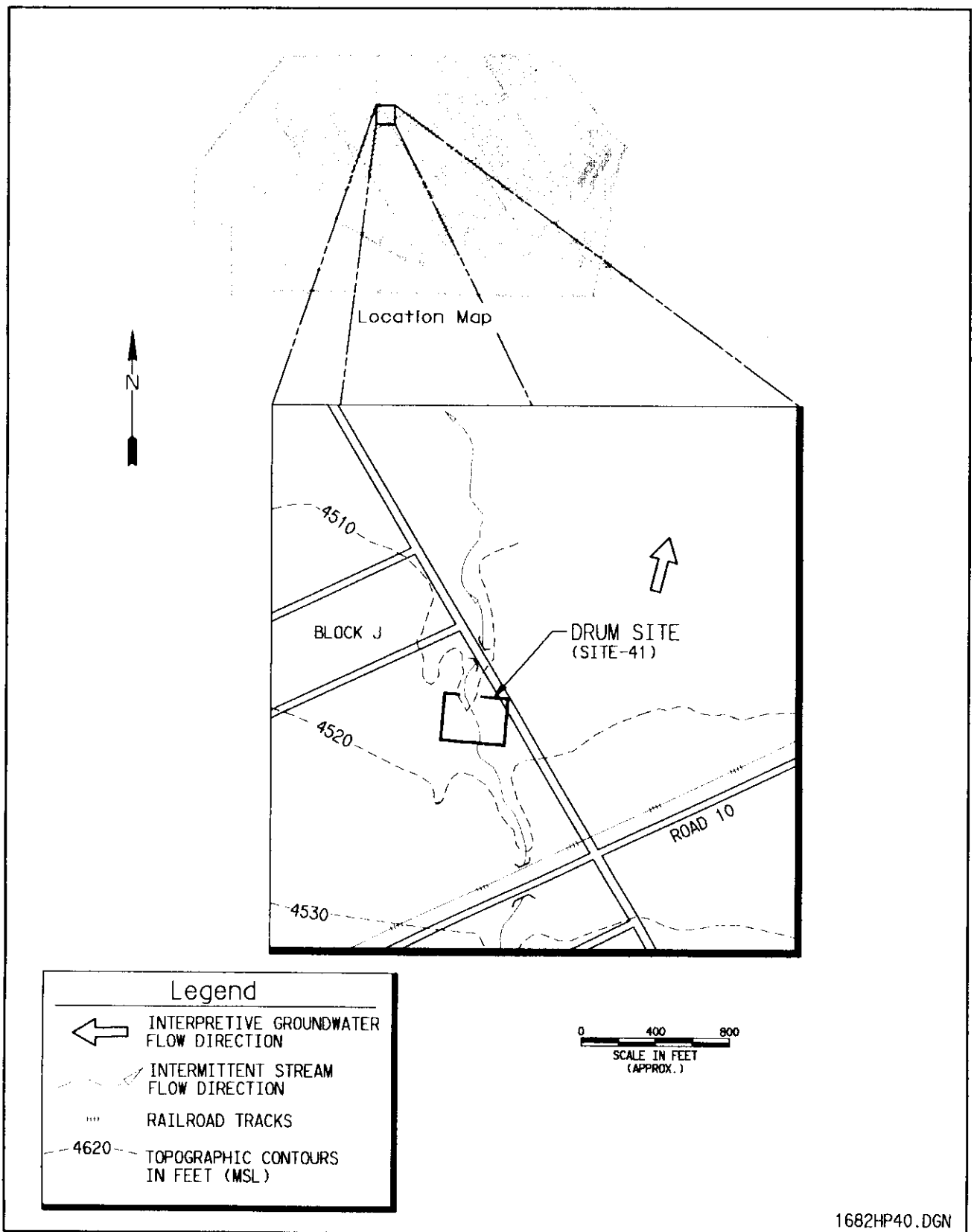
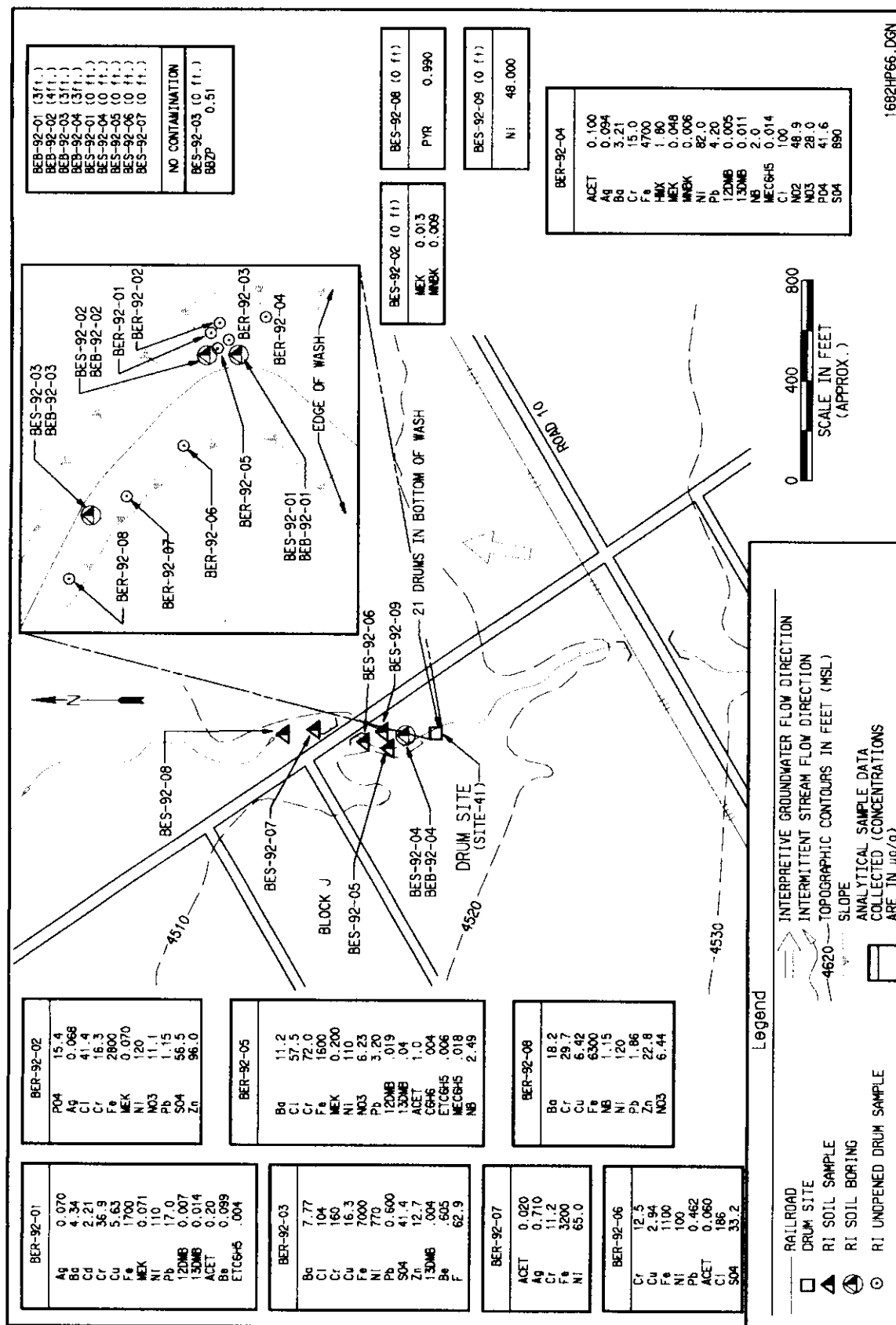


Figure 6-1. Location Map of the Box Elder Wash Drum Site (Site 41)



1682HP66.DGN

Figure 6-2. Distribution of Soil Contamination and Drum Contents at the Box Elder Wash Drum Site (Site 41)

Table 6-1. Summary of Analytes Detected in Drum Samples from the Box Elder Wash Drum Site (Site 41)

Analyte	BER-92-01	BER-92-02	BER-92-03	BER-92-04	BER-92-05	BER-92-06	BER-92-07	BER-92-08
Concentrations in µg/g								
VOCs								
1,2-Dimethylbenzene	0.007	ND	ND	0.005	0.019	ND	ND	ND
1,3-Dimethylbenzene	0.014	ND	0.004	0.011	0.04	ND	ND	ND
Acetone	0.2	ND	ND	0.1	1	0.06	0.02	ND
Ethylbenzene	0.004	LT	LT	LT	0.006	LT	LT	LT
Methyl Ethyl Ketone	0.071	0.07	ND	0.048	0.2	ND	ND	ND
Methyl N-Butyl Ketone	ND	ND	ND	0.0096	ND	ND	ND	ND
Toluene	LT	LT	LT	0.014	0.018	LT	LT	LT
Benzene	LT	LT	LT	LT	0.004	LT	LT	LT
ANIONS								
Chloride	LT	41.4	104	100	57.5	186	LT	LT
Fluoride	LT	LT	62.9	LT	LT	LT	LT	LT
Nitrate	LT	11.1	LT	28	6.23	LT	LT	6.44
Nitrite	LT	LT	LT	48.9	LT	LT	LT	LT
Phosphate	ND	15.4	ND	41.6	ND	ND	ND	ND
Sulfate	LT	56.5	41.4	890	LT	33.2	LT	LT
METALS								
Barium	4.34	LT	7.77	3.21	11.2	LT	LT	18.2
Beryllium	0.099	LT	0.605	LT	LT	LT	LT	LT
Cadmium	2.21	LT	LT	LT	LT	LT	LT	LT
Chromium	36.9	16.3	160	15	72	12.5	11.2	29.7

Table 6-1. Summary of Analytes Detected in Drum Samples from the Box Elder Wash Drum Site (Site 41) (continued)

Analyte	BER-92-01	BER-92-02	BER-92-03	BER-92-04	BER-92-05	BER-92-06	BER-92-07	BER-92-08
Concentrations in $\mu\text{g/g}$								
METALS (cont.)								
Copper	5.63	LT	16.3	LT	LT	2.94	LT	6.42
Iron	1700	2800	700	470	1600	1100	3200	6300
Lead	17	1.15	0.6	4.2	3.2	0.462	LT	1.86
Nickel	110	120	770	82	110	100	65	120
Silver	0.07	0.068	LT	0.094	LT	LT	0.71	LT
Zinc	LT	96	12.7	LT	LT	LT	LT	22.8
EXPLOSIVES								
HMX	LT	LT	LT	1.8	LT	LT	LT	LT
Nitrobenzene	ND	LT	LT	2	2.49	ND	LT	1.15

ND = Analyte not detected in sample.
 LT = Analyte is less than certified reporting limits.

Analyses of samples from the drum contents included the TCLP for metals (Table 6-2). These analyses showed that the drum contents pass the TCLP test for metals.

6.1.3 Contaminant Fate and Transport

Pyrene strongly adsorbs to soil and is resistant to leaching. Leaching of pyrene to the groundwater at Site 41 is highly unlikely because of the depth to groundwater at the site, the low concentration of pyrene detected in the soil (detected in 1 sample out of 13), and the strong adherence of pyrene to soils. Pyrene exhibits low volatilization rates, although it may enter the atmosphere through adsorption to airborne particulates with removal occurring through wet and dry deposition. Pyrene is not expected to be appreciably taken up by plants but can bioconcentrate in animal tissue. The potential for pyrene to bioaccumulate at Site 41 is minimal because of its low concentration and infrequent detection.

6.1.4 Summary of the Baseline Risk Assessment

The purpose of the BRA is to evaluate potential human health risks associated with the no-action alternative. The initial task of the assessment involves identification of chemicals present at the site that pose a potential risk to human health based on their prevalence and concentration in the environment and inherent toxicity. After potential contaminants of concern are identified, a toxicity assessment is conducted to estimate the relationship between the extent of exposure to a contaminant and the increased likelihood and/or severity of adverse effects. Then, an exposure assessment is performed to evaluate the pathways by which humans could potentially contact contaminants. The final task consists of determining the magnitude and probability of current and future human health risks associated with the contaminants of concern. This section summarizes the results of the BRA that was completed as part of the RI for TEAD-N (Rust E&I, 1994).

6.1.4.1 Human Health Risk Assessment

As more fully discussed in the RI Report for TEAD-N, the most likely exposure pathways for contaminants at Site 41 are via dermal contact, incidental soil ingestion, inhalation of fugitive dust, and ingestion of beef derived from cattle potentially exposed to contamination while grazing at TEAD-N. However, fugitive dust emissions from Site 41 are minimal because of the vegetative cover at this site that limits potential dust emissions.

The risk assessment evaluates scenarios for both present land use and future land use conditions. Since no construction is planned for Site 41, the construction worker scenario can be considered a future case. The scenario for future on-site residential use is the most conservative future land use scenario. Residential development at Site 41 is questionable because of its location in a drainage area.

Table 6-2. Summary of TCLP Metals in Drum Samples from the Box Elder Wash Drum Site (Site 41)

Analyte	BER-92-01	BER-92-02	BER-92-03	BER-93-04	BER-92-05	BER-92-06	BER-92-07	BER-92-08	Regulatory Limit
Concentrations in mg/L									
Arsenic	LT ^(a)	LT	LT	LT	LT	LT	LT	LT	5.0
Barium	0.430	0.150	0.120	1.70	0.330	0.190	0.160	0.260	100.0
Cadmium	0.006	LT	LT	LT	LT	LT	LT	LT	1.0
Chromium	0.027	0.016	0.020	0.043	0.094	0.009	0.009	LT	5.0
Lead	LT	LT	LT	LT	LT	LT	LT	LT	5.0
Mercury	0.001	-- ^(b)	--	--	--	--	--	--	0.2
Selenium	LT	LT	LT	LT	LT	LT	LT	LT	1.0
Silver	LT	LT	LT	LT	LT	LT	LT	LT	5.0

^aLT=Analyte is less than sample quantitation limit.

^b--=Laboratory did not perform TCLP analysis based on non-detects for total analysis.

Under current land use conditions, human receptors include the on-site worker, installation resident, installation school student/employee, and off-site resident from the nearby cities of Tooele, Stockton, and Grantsville. The on-site worker is potentially exposed through incidental ingestion of soil, dermal contact, and inhalation of fugitive dust. For the remaining current land use receptors, inhalation of fugitive dust and consumption of contaminated beef are considered complete, potential exposure pathways. Complete exposure pathways for the future on-site residential scenario include the aforementioned pathways as well as consumption of homegrown produce. The construction worker is potentially exposed through incidental ingestion of soil, dermal contact, and inhalation of fugitive dust.

For the complete exposure pathways discussed above, two exposure cases are analyzed as part of the BRA. The central tendency risk description presented in Table 6-3 is the arithmetic mean risk and is derived by using average exposure values for each pathway/site considered. The RME description presented in Table 6-4 is the high end risk. The RME is estimated by combining upper bound values (95 percent upper confidence limits of the arithmetic mean) so that the result represents an exposure scenario that is both protective and reasonable (EPA, 1991a). Both Tables 6-3 and 6-4 include the noncarcinogenic risk estimates for all complete pathways. Carcinogenic risk estimates were not calculated for pyrene because pyrene is not classified as a human carcinogen. This is based on the unavailability of human data and mixed results in animal studies that have been completed to date (EPA, 1993).

The chronic, noncarcinogenic risk estimates all meet the EPA goal for a residual hazard index of 1 or less. The extent of actual contamination at Site 41 appears minimal because of the low frequency of detection and the low concentration detected for soil contamination.

6.1.4.2 Ecological Risk Assessment

The ecological risk assessment for Site 41 was qualitative and did not include a detailed inventory or bioassays of the vegetation and animals. Human activity at Site 41 is infrequent. The predominant vegetation consists of sagebrush and grasses. Site 41 is within an igloo storage compound that is surrounded by an 8-foot security fence. The fence prevents entrance by large game animals, but the site is accessible to all other wildlife, in particular small mammals, raptors, and other birds.

The primary contaminants of concern at Site 41, from an ecological standpoint, are pyrene and metals. These contaminants are toxic and may bioaccumulate. Potential exposure scenarios include the ingestion of soil contamination by burrowing mammals and birds and the subsequent ingestion of these animals by raptors. Pyrene was not detected in samples from the drum contents, and was detected in only one soil sample at a low concentration. Therefore, the potential for exposure to this contaminant by ecological receptors is low. Nickel is the only metal that was detected in soil at a level above background. It was detected only in the sample collected at the surface tar spill above the wash. The concentration of nickel was approximately two times the soil background, and reflects the nickel concentrations found in the drummed material. Nickel was not present above the

Table 6-3. Summary of Human Health Risk Assessment Results Using Average Exposure Levels for Site 41

Analyte	On-Site Worker ^(a)		Construction Worker ^(b)		Installation School ^(c)		Installation Resident ^(d)		Off-Site Resident ^(e) Tooele		Off-Site Resident ^(e) Stockton		Off-Site Resident ^(e) Grantsville		Future On-Site ^(f) Resident	
	RF ^(g)	HI ^(g)	RF	HI	RF	HI	RF	HI	RF	HI	RF	HI	RF	HI	RF	HI
<u>Ingestion</u>																
Pyrene		8.04E-06			6.39E-06											1.16E-04
<u>Inhalation</u>																
Pyrene		1.41E-09			1.41E-09			2.12E-09		3.38E-11		2.90E-11		6.13E-11		2.12E-09
<u>Dermal</u>																
Pyrene		3.46E-06			2.75E-06											3.24E-06
<u>Beef Consumption</u>																
Pyrene							3.84E-05		3.84E-05		3.84E-05		3.84E-05			3.84E-05
<u>Vegetable Consumption</u>																
Pyrene																1.13E-05
<u>Fruit Consumption</u>																
Pyrene																6.30E-06
Site Total		1.15E-05			9.14E-06		7.92E-10	3.84E-05	3.84E-05	3.84E-05	3.84E-05	3.84E-05	3.84E-05	3.84E-05		1.75E-04

^(a)On-Site Worker is assumed to work at Site 41 10 hours per day 250 days per year for 10 years.

^(b)Construction Worker is assumed to work at Site 41 10 hours per day for 250 days.

^(c)Installation School Students/Employees are assumed to be at the school site 5 hours per day 200 days per year for 2 years.

^(d)Installation Resident is assumed to live on TEAD-N for 2 years.

^(e)Off-Site Residents are assumed to live in the TEAD-N vicinity for 2 years.

^(f)Future On-Site Residents are assumed to live on Site 41 land for 9 years.

^(g)Risk factor.

^(h)Hazard index.

Table 6-4. Summary of Human Health Risk Assessment Results Using Reasonable Maximum Exposure Levels for Site 41

Analyte	On-Site Worker ^(a)		Construction Worker ^(b)		Installation School ^(c)		Installation Resident ^(d)		Off-Site Resident ^(e) Tooele		Off-Site Resident ^(e) Stockton		Off-Site Resident ^(e) Grantsville		Future On-Site ^(f) Resident	
	RF ^(g)	HI ^(g)	RF	HI	RF	HI	RF	HI	RF	HI	RF	HI	RF	HI	RF	HI
<u>Ingestion</u>																
Pyrene		1.61E-05		6.14E-05											2.33E-04	
<u>Inhalation</u>																
Pyrene		1.41E-09		2.13E-09		7.92E-10		1.71E-08		2.89E-10		2.34E-10		4.95E-10		1.71E-08
<u>Dermal</u>																
Pyrene		1.73E-05		1.37E-05											7.94E-05	
<u>Beef Consumption</u>																
Pyrene								3.71E-04		3.71E-04		3.71E-04		3.71E-04		3.71E-04
<u>Vegetable Consumption</u>																
Pyrene															1.02E-04	
<u>Fruit Consumption</u>																
Pyrene															5.36E-05	
Site Total		3.34E-05		7.51E-05		7.92E-10		3.71E-04		3.71E-04		3.71E-04		3.71E-04		8.39E-04

^(a)On-Site Worker is assumed to work at Site 41 10 hours per day 250 days per year for 25 years.

^(b)Construction Worker is assumed to work at Site 41 10 hours per day for 250 days.

^(c)Installation School Students/Employees are assumed to be at the school site 7 hours per day 200 days per year for 4 years.

^(d)Installation Resident is assumed to live on TEAD-N for 2 years as a child and 7 years as an adult.

^(e)Off-Site Residents are assumed to live in the TEAD-N vicinity for 30 years.

^(f)Future On-Site Residents are assumed to live on Site 41 land for 30 years.

^(g)Risk factor.

^(h)Hazard index.

certified reporting limits in any of the soil samples collected from soils in the wash. Therefore, the potential for ecological receptors to be exposed to metals in soil is low. However, several metals were detected in samples of the drum contents. The drum contents could pose a threat to wildlife because small mammals may use the drums as a habitat to build nests. The tarry nature of the drum contents limits the potential for exposure, except when the tar is softened by heat. Overall, the risk to ecological receptors at Site 41 appears to be low for the soil and moderate for the drums.

6.1.5 Remedial-Action Objectives for Soils and Drums

Available data show that the drum contents are potentially hazardous. Therefore, the remedial objective for the drums at Site 41 is to properly treat or dispose of the drum contents and stained soils.

The following risk-based remediation levels are the remediation goals for soil at Site 41: (1) limit the cumulative excess cancer risk to human receptors to levels within or below the EPA target range for residual risk of $1E-4$ to $1E-6$ and (2) limit the cumulative noncancer hazard index to levels of 1 or less. The remedial-action objectives for soil at Site 41 are to (1) prevent human and environmental (i.e., fauna and flora) exposure to soil contamination that is present at concentrations above the risk-based remediation levels and (2) prevent migration of soil contaminants that are present at concentrations above the risk-based remediation levels to surface water and groundwater. The Baseline Risk Assessment for Site 41 indicates that the current condition of the soils at the site meets the remediation goals.

6.1.6 General Response Actions for Soils and Drums

For Site 41, available data indicate that the current condition of the soils at the site meets the remediation goals. The 21 drums do require remediation because the contents of these drums are potentially hazardous. Removal of stained soils associated with the drums and the small tar spill above the wash should be included. The general response actions that are available for Site 41 include:

- No action
- Institutional controls
- Containment
- In-situ treatment
- Excavation with on-site treatment and disposal
- Excavation with off-site treatment and/or disposal

6.1.7 Identification and Screening of Remedial Technologies for Soils and Drums

A variety of remedial technologies are available for the soils and drums at Site 41. Table 6-5 identifies these technologies and screens them according to effectiveness, implementability, and cost. The applicability of each technology depends on factors such as the remediation goals, whether the technology is suitable for the site contaminants and concentrations, and site characteristics.

As a result of the screening shown in Table 6-5, the following technologies have been retained for further consideration during the development of remedial alternatives for soils and drums at Site 41:

- No action
- Institutional controls
 - Deed restrictions
 - Fences
- Excavation with off-site treatment and/or disposal
 - Off-site landfill (drums and stained soil)
 - Off-site incineration (drums and stained soil)

ARARs have been screened from the documents in Appendix A and Table 1-1. Table 6-6 summarizes ARAR choices for Site 41. These are analyzed further in Section 6.1.9.

6.1.8 Development of Remedial Alternatives for Soils and Drums

The BRA for Site 41 indicates that the current condition of the soils at the site meets the remediation goals for soil. The drums at Site 41, however, potentially pose a threat to human health and the environment. Four remedial alternatives are being considered for this site:

Alternative 1: No Action. Site soils and the drums would remain in place.

Alternative 2: Institutional Controls. This alternative does not involve active remediation; site soils and the drums would be left in place. However, this alternative would limit the potential for human and fauna exposure to site contaminants by placing controls on access to the site. These controls would include fences or other barriers, warning signs, and regular surveillance. Deed restrictions would be developed for future protection in the event the property were released to the public.

Alternative 3: Removal and Off-Site Incineration of Drums and Stained Soils. This alternative includes the removal and off-site incineration of 21 drums and approximately 35 cubic feet of visibly stained soil from Site 41. The material would be properly handled and

Table 6-5. Technology Screening for Soils and Drums at the Box Elder Wash Drum Site (Site 41)

Technology	Effectiveness	Implementability	Cost	Screening Results
No Action	Effective for soil because contamination levels do not pose an excessive human health or environmental risk. Not effective for drums because contamination levels potentially exceed ARARs ^(c) for hazardous waste.	NA ^(a)	No cost.	Consider. Required for consideration by the NCP ^(b) .
Institutional Controls				
Deed Restrictions	As long as the site is Army property, deed restrictions are not necessary to control the use of the land. Does not reduce contamination.	Readily implementable. ^(d)	Negligible cost.	Consider. Will provide for future public use.
Fences	Long-term enforcement necessary to restrict access to the site. Does not reduce contamination.	Readily implementable.	Low cost. \$25/LF. ^(e)	Consider.
Containment				
Surface Runoff Controls	Does not reduce contamination or prevent exposure by humans, fauna, and flora. Reduces potential for contaminant migration through erosion and leaching. Long-term maintenance and institutional controls necessary.	Readily implementable.	Low cost. Less than or comparable to capping.	Eliminate. Volume of surface runoff small.
Capping	Does not reduce contamination. Prevents exposure by humans, fauna, and flora. Prevents erosion and infiltration of water. Long term maintenance and institutional controls necessary.	Readily implementable.	Low cost. \$10 to \$70/SY. ^(f)	Eliminate. Site topography is unsuitable.

Table 6-5. Technology Screening for Soils and Drums at the Box Elder Wash Drum Site (Site 41) (continued)

Technology	Effectiveness	Implementability	Cost	Screening Results
In situ Treatment				
Biodegradation	Provides destruction of biodegradable organic contaminants. In-situ treatment is not appropriate for drums. Organic concentrations in soil are too low to establish an effective microbial population.	NA	NA	Eliminate. Organic concentrations in soil are too low for effective treatment.
Radio Frequency Heating	Process extracts contaminants through enhanced volatilization. In-situ treatment is not appropriate for drums. Organic concentrations in soil are too low for effective treatment.	Process is at the laboratory research and field demonstration stages of development.	Moderate to high cost because of energy use.	Eliminate. Organic concentrations in soil are too low for effective treatment.
Soil Vapor Extraction	Process extracts volatile organic contaminants from soil. In-situ treatment is not appropriate for drums. Organic concentrations in soil are too low for effective treatment.	Readily implementable.	Low to high cost. \$10 to \$150/ton	Eliminate. Volatile organic concentrations in soil are too low for effective treatment.
Stabilization	Creates a solid monolith that is resistant to leaching. Does not reduce contaminant toxicity or volume. In-situ treatment is not appropriate for drums.	Contaminant concentrations in soil are too low for practical application.	Low cost. \$30 + /ton	Eliminate. Contaminant concentrations in soil are too low for practical application.
Vitrification	Creates a solid, glassy monolith that is highly resistant to leaching. Reduces contaminant volume but does not reduce toxicity. In-situ treatment is not appropriate for drums.	Contaminant concentrations in soil are too low for practical application. Only one vendor is available.	High cost due to high energy consumption.	Eliminate. Contaminant concentrations in soil are too low for practical application.

Table 6-5. Technology Screening for Soils and Drums at the Box Elder Wash Drum Site (Site 41) (continued)

Technology	Effectiveness	Implementability	Cost	Screening Results
Excavation with On-Site Treatment and Disposal				
Biological Treatment	Provides destruction of biodegradable organic contaminants. This process is not appropriate for drums. Organic levels in soil are too low to establish an effective microbial population.	NA	NA	Eliminate. Organic concentrations in soil are too low for effective treatment. Will not remove nickel.
Chemical Extraction	Process extracts organic contaminants. This process is not appropriate for drums. Organic levels in soil are too low for effective treatment.	Process is still largely at the pilot scale and demonstration stages of development. Few treatment units are available.	High cost. \$100 to \$500/ton.	Eliminate. Organic concentrations in soil are too low for effective treatment.
Dechlorination	Process extracts and detoxifies chlorinated aromatic organics. None of the contaminants of concern are chlorinated aromatic organics.	NA	NA	Eliminate.
Incineration	Provides thermal destruction of organic contaminants.	Mobile incinerator capacity currently unavailable.	High cost. \$300 to \$600/ton.	Eliminate. Unavailability of mobile incinerator.
Physical Separation	Reduces contaminant volume by separating out the fine-grained materials (assuming contaminants are adsorbed to silts and clays). This process is not appropriate for drums. Organic levels in soil are too low for effective treatment.	Readily implementable.	Low to moderate cost. Less than or comparable to soil washing.	Eliminate. Organic concentrations in soil are too low for effective treatment.

Table 6-5. Technology Screening for Soils and Drums at the Box Elder Wash Drum Site (Site 41) (continued)

Technology	Effectiveness	Implementability	Cost	Screening Results
Soil Washing	Reduces contaminant volume by separating out the fine-grained materials (assuming contaminants are adsorbed to silts and clays). Generates wastewater that may require treatment. This process is not appropriate for drums. Organic levels in soil are too low for effective treatment.	Readily implementable.	Moderate cost. \$40 to \$50/ton.	Eliminate. Organic concentrations in soil are too low for effective treatment.
Stabilization	Creates a solid monolith that is resistant to leaching. Does not reduce contaminant toxicity or volume. This process is not appropriate for drums. Primarily intended for treatment of inorganics, but can be used for treatment of organic contaminants in soil if concentrations are low, generally less than 20% by weight.	Contaminant levels in soil are too low for practical treatment. ^⓪	Low to high cost. \$30 to \$250/ton.	Eliminate. Contaminant concentrations in soil are too low for practical treatment.
Thermal Desorption	Extracts organic contaminants through enhanced volatilization. This process is not appropriate for drums. Organic levels in soil are too low for effective treatment.	A shortage in thermal desorption capacity exists.	High cost. \$300 to \$800/ton.	Eliminate. Organic concentrations in soil are too low for practical treatment.
Volatilization	Process extracts volatile organic contaminants from soil. This process is not appropriate for drums.	Organic levels in soil are too low for practical treatment. ^⓪	Low cost. \$20 to \$50/ton.	Eliminate. The concentrations of volatile organics in soil are too low for practical treatment.

Table 6-5. Technology Screening for Soils and Drums at the Box Elder Wash Drum Site (Site 41) (continued)

Technology	Effectiveness	Implementability	Cost	Screening Results
Excavation with Off-Site Treatment and/or Disposal				
Incineration	Process provides destruction of organic contaminants.	Incinerator facilities locally available.	High cost. \$900 to \$4200/ton.	Consider.
Landfill	Removes contaminated soil and/or drums from the site and eliminates the need for long-term management of the site. Safe excavation and transport are short-term concerns. Long-term effectiveness depends on pretreatment and disposal practices at the receiving facility.	Requires landfill that has proper permits for receiving hazardous materials (e.g. RCRA landfill).	Moderate to high cost. \$100 to \$250/ton.	Consider.

*NA = not applicable.

^bNCP = National Contingency Plan.

^cARARs = Applicable or Relevant and Appropriate Requirements.

^dReadily implementable technologies are those for which services or vendors are available.

^eLF = linear foot.

^fSY = square yard.

Table 6-6. Compliance of Alternatives with ARARs for Site 41

Statute	Alternative 1: No Action		Alternative 2: Institutional Controls		Alternative 3: Incineration of Soil and Drums		Alternative 4: RCRA Approved Landfill Disposal	
	Meets Stds.	Does Not Meet Stds.	Meets Stds.	Does Not Meet Stds.	Meets Stds.	Does Not Meet Stds.	Meets Stds.	Does Not Meet Stds.
OSHA	NA		X		X		X	
Utah Air Conservation Act	NA		NA		X*		X*	
Utah Corrective Action Clean-Up Standards Policy (UAC-R-315-101)		X		X	X		X	
Utah Transporter and Landfill Disposal Standards (R315-1 through -10)	NA		NA		X		X**	
Safe Drinking Water Act (MCLs)	X		X		X		X	
40 CFR Part 268 Landfill Disposal	NA		NA		X		X**	
40 CFR Part 264 TSD Stds.	NA		NA		X		X	
Utah Groundwater Protection Rule	X		X		X		X	
Utah Safe Drinking Water Act (MCLs)	X		X		X		X	
Hazardous Material Transport Act	NA		NA		X		X	

NA = not applicable.

* = action-specific, would apply during cleanup.

** = pretreatment standards may apply.

incinerated in a permitted hazardous waste incinerator. The material would be transported by licensed hazardous waste handlers utilizing manifests to track the shipment and to track the receipt of the waste at a licensed hazardous waste treatment, storage, and disposal facility. The materials may require treatment as part of, or prior to, disposal.

Alternative 4: Removal and Off-Site Landfill Disposal of Drums and Stained Soils. This alternative includes the removal and off-site disposal of 21 drums and approximately 35 cubic feet of visibly stained soil from Site 41. The material would be properly handled and placed in a permitted hazardous waste landfill. The material would be transported by licensed hazardous waste handlers utilizing manifests to track the shipment and to track the receipt of the waste at a licensed hazardous waste treatment, storage, and disposal facility. The materials may require treatment as part of, or prior to, disposal.

6.1.9 Detailed Analysis of Alternatives for Soils and Drums

6.1.9.1 *Alternative 1: No Action*

Overall protection of human health and the environment. This alternative does not meet the remedial-action objectives because the drums, which contain materials that are characteristic of hazardous waste, would be left on-site.

Compliance with ARARs. This alternative does not comply with source control requirements in UAC-R-315-101. The alternative does comply with the Safe Drinking Water Act (SDWA) MCLs, Utah SDWA MCLs, and the Utah Ground Water Protection Rule.

Long-term effectiveness and permanence. The BRA indicates that the residual risk for potential exposure to soils would meet the remediation goals of limiting the cumulative excess cancer risk to human receptors to levels below the EPA target range for residual risk of $1\text{E-}4$ to $1\text{E-}6$ and limiting the cumulative noncancer hazard index to levels of 1 or less. However, the contents of the drums, which are potentially hazardous, pose a threat to ecological receptors.

Reduction of toxicity, mobility, or volume through treatment. There is no reduction of the toxicity, mobility, or volume of contaminants in the soil or in the drum contents through treatment under this alternative.

Short-term effectiveness. Because the no-action alternative involves no construction or other implementation activities, there are no short-term hazards to human health or the environment associated with this alternative.

Implementability. There are no implementability concerns for the no-action alternative.

Cost. There are no costs for the no-action alternative.

State acceptance. This criterion will be evaluated following regulatory review of this FS.

Community acceptance. This criterion will be evaluated during the public comment period that will follow release of the RI and FS reports to the community.

6.1.9.2 Alternative 2: Institutional Controls

Overall protection of human health and the environment. This alternative does not meet the remedial-action objectives because the drums, which contain materials that are characteristic of hazardous waste, would be left on-site.

Compliance with ARARs. This alternative does not comply with source control requirements in UAC-R-315-101. The alternative does comply with SDWA MCLs, Utah SDWA MCLs, and the Utah Ground Water Protection Rule. It meets OSHA Worker Health and Safety Standards.

Long-term effectiveness and permanence. The contents of the drums, which are potentially hazardous, pose a threat to ecological receptors because the drums would remain on-site with this alternative. The BRA indicates that the residual risk for potential exposure to soils would meet the remediation goals of limiting the cumulative excess cancer risk to human receptors to levels below the EPA target range for residual risk of $1E-4$ to $1E-6$ and limiting the cumulative noncancer hazard index to levels of 1 or less. By using fences or other access restrictions to reduce the amount of time that on-site workers are allowed on the site, institutional controls could exceed the remediation goals for soils by reducing health risk to on-site workers. Deed restrictions would provide for future protection in the event of release of the property to the public. The installation of a fence is not expected to impact the environment. Because the fence would cross the wash, the fence may require maintenance during flood events, which are expected to be infrequent.

Reduction of toxicity, mobility, or volume through treatment. There is no reduction of the toxicity, mobility, or volume of contaminants in the soil or in the drum contents through treatment under this alternative.

Short-term effectiveness. Human health concerns associated with the implementation of this alternative are limited to the construction hazards of personnel who would be involved with the installation of a fence or other barriers at the site. The implementation time would be sufficiently short (less than 1 month), so that the health risk due to potential exposure to site contaminants would be negligible. Wildlife may be temporarily disturbed by the construction activities.

Implementability. Institutional controls involve simple activities such as the installation of fences and surveillance. This alternative is, therefore, readily implementable.

Cost. Costs for installation and maintenance of a chain link fence around the perimeter of this site are summarized below and detailed in Appendix B.

Capital: \$19,500
Annual O&M Costs: \$500
Present Worth of O&M at 5 percent: \$7,700
Total Capital and Present Worth: \$27,200

The cost of obtaining deed restrictions assumes the use of existing staff and is negligible.

State acceptance. This criterion will be evaluated following regulatory review of this FS.

Community acceptance. This criterion will be evaluated during the public comment period that will follow release of the RI and FS reports to the community.

6.1.9.3 Alternative 3: Removal and Off-Site Incineration of Drums and Stained Soil

Overall protection of human health and the environment. This alternative meets the remedial-action objectives for the drum contents and for the soil.

Compliance with ARARs. The transporter, plus the owner and operator of the facility that receives the drums, would comply with appropriate requirements as outlined in 40 CFR 264, 40 CFR 268.50, and UAC-R-315-1 through UAC-R-315-10. This alternative complies with SDWA MCLs, Utah SDWA MCLs, and the Utah Ground Water Protection Rule. This alternative would comply with OSHA requirements for worker health and safety (29 CFR 1910 and 20 CFR 1926) during excavation and haulage. The Utah Air Conservation Act (19-2-101, Citations R307-1-3.1.8(A), R307-1-4.5.2 and R307-1-3.2) would be an action specific ARAR to regulate fugitive dust and particulates.

Long-term effectiveness and permanence. The BRA indicates that the residual risk for this alternative would meet the remediation goals of limiting the cumulative excess cancer risk to all current human receptors to levels below the EPA target range for residual risk of 1E-4 to 1E-6 and limiting the cumulative noncancer hazard index to human receptors to levels of 1 or less. This alternative eliminates the need for long-term management of the site.

Reduction of toxicity, mobility, or volume through treatment. This alternative provides permanent on-site reductions in the toxicity, mobility, and volume of the drum contents and soil contaminants through removal and off-site incineration, but there is no overall reduction in volume from incineration.

Short-term effectiveness. Human health concerns associated with the implementation of this alternative are limited to the physical hazards to personnel who would be involved with the removal and off-site transport of drums from the site. The implementation time would be sufficiently short (approximately 1 month) and appropriate personal protective equipment would be utilized, so that the health risk due to potential exposure to site contaminants would be negligible. Wildlife may be temporarily disturbed during removal and shipment of the drums.

Implementability. Removal and disposal services for the 21 drums and stained soil are readily available.

Cost. The estimated cost for removing the drums, incineration, and disposal in an approved landfill is \$222,000, as detailed in Appendix B. There are no on-going costs once the drums and stained soils are removed and incinerated.

State acceptance. This criterion will be evaluated following regulatory review of this FS.

Community acceptance. This criterion will be evaluated during the public comment period that will follow release of the RI and FS reports to the community.

6.1.9.4 *Alternative 4: Removal and Off-Site Disposal of Drums and Stained Soil*

Overall protection of human health and the environment. This alternative meets the remedial-action objectives for the drums and for soils.

Compliance with ARARs. The transporter, plus the owner and operator of the facility that receives the drums, would comply with appropriate requirements as outlined in 40 CFR 264, 40 CFR 268, and UAC-R-315-1 through -10. This alternative complies with SDWA MCLs, Utah Safe Drinking Water Act MCLs, and the Utah Ground Water Protection Rule. This alternative would comply with OSHA requirements for worker health and safety (29 CFR 1910 and 20 CFR 1926) during excavation and haulage. The Utah Air Conservation Act (19-2-101, Citations R307-1-3.1.8(A), R307-1-4.5.2 and R307-1-3.2) would be an action specific ARAR to regulate fugitive dust and particulates. For RCRA landfill disposal, pretreatment standards may apply.

Long-term effectiveness and permanence. The BRA for this alternative indicates that the residual risk would meet the remediation goal of limiting the cumulative excess cancer risk to human receptors to levels below the EPA target range of 1E-4 to 1E-6 and limiting the cumulative noncancer hazard index to less than 1. This alternative eliminates the need for long-term management of the site.

Reduction of toxicity, mobility and volume through treatment. This alternative permanently removes all of the contaminated drums and soil from the site but does not reduce toxicity, mobility, and volume of contaminants through treatment.

Short-term effectiveness. Human health concerns associated with the implementation of this alternative are derived from physical hazards to field personnel. An implementation time of approximately 1 month and appropriate use of personal protective equipment would cause negligible exposure to site contaminants. Wildlife may be temporarily disturbed during the construction activities.

Implementability. Removal and disposal services for the soil are readily available.

Cost. The total estimated capital cost to remove the drums and to excavate, load, haul, and dispose of the soil is \$193,000, as detailed in Appendix B. There are no on-going annual operations and maintenance costs associated with this alternative.

State acceptance. This criterion will be evaluated following regulatory review of this FS.

Community acceptance. This criterion will be evaluated during the public comment period that will follow release of the RI and FS reports to the community.

6.1.10 Comparative Analysis of Remedial Alternatives for Soils and Drums

Table 6-7 provides a comparative analysis of Alternatives 1 through 4 for Site 41.

6.1.11 Remedial-Action Objectives for Groundwater and Surface Water

Surface-water flow through Box Elder Wash is from intermittent runoff of spring snowmelt or during periods of high precipitation. Surface water eventually infiltrates into the subsurface and may serve as a recharge source to groundwater. However, there is no information to indicate that groundwater contamination has occurred. The depth to groundwater is approximately 220 feet below Site 41.

The groundwater and surface-water remedial-action objective for Site 41 would be to reduce contaminant levels to below MCLs. Meeting this objective reduces risk to human health to acceptable levels and maintains the quality of water for future use. The RI indicates that the current condition of the site meets the objective. Removal of the drums would significantly reduce any possible future groundwater contamination.

6.1.12 General Response Action for Groundwater and Surface Water

Although available information indicates that the current condition of Site 41 meets the remedial-action objective and that remediation is not required, remedial technologies have been identified in conformance with regulatory processes. These response actions include:

- No action
- Monitoring
- Institutional controls
- Extraction followed by treatment
- Containment

Because of the indicated conclusion that the remedial-action objective is currently being met, the no-action alternative is the only one chosen for development.

Table 6-7. Comparative Analysis of Remedial Alternatives for Soils and Drums at Site 41

Criterion	Alternative 1: No Action	Alternative 2: Institutional Controls	Alternative 3: Removal and Off-Site Incineration of Drums and Stained Soil	Alternative 4: Removal and Off-Site Disposal of Drums and Stained Soil
Overall Protection	Does not meet the remedial-action objectives of protecting human health and the environment because the drums would remain on site.	Does not meet the remedial-action objectives of protecting human health and the environment because the drums would remain on site.	Meets the remedial-action objectives of protecting human health and the environment.	Meets the remedial-action objectives of protecting human health and the environment.
Compliance with ARARs ⁽⁶⁾	Does not comply with land disposal restrictions because the drums contain potentially hazardous waste.	Does not comply with land disposal restrictions because the drums contain potentially hazardous waste. Complies with OSHA ⁽⁶⁾ requirements for worker health and safety during implementation.	Complies with ARARs for transport of the drums to an off-site hazardous waste disposal facility. Complies with OSHA requirements for worker health and safety during implementation.	Complies with ARARs for transport of the drums to an off-site hazardous waste disposal facility. Complies with OSHA requirements for worker health and safety during implementation.
Long-Term Effectiveness	Would meet the remediation goals for soil of limiting the cumulative excess cancer risk to human receptors to levels within or below the EPA target range for residual risk of 1E-4 to 1E-6 and limiting the cumulative noncancer hazard index to levels of 1 or less. The drum contents pose a threat to potential ecological receptors.	Would meet the remediation goals for soil of limiting the cumulative excess cancer risk to human receptors to levels within or below the EPA target range for residual risk of 1E-4 to 1E-6 and limiting the cumulative noncancer hazard index to levels of 1 or less. The drum contents pose a threat to potential ecological receptors.	Would meet the remediation goals for soil of limiting the cumulative excess cancer risk to human receptors to levels below the EPA target range for residual risk of 1E-4 to 1E-6 and limiting the cumulative noncancer hazard index to levels of 1 or less. Would protect the environment and eliminate the need for long-term management of the site through the removal and proper off-site disposal of the 21 drums and stained soil.	Would meet the remediation goals for soil of limiting the cumulative excess cancer risk to human receptors to levels below the EPA target range for residual risk of 1E-4 to 1E-6 and limiting the cumulative noncancer hazard index to levels of 1 or less. Would protect the environment and eliminate the need for long-term management of the site through the removal and proper off-site disposal of the 21 drums and stained soil.

Table 6-7. Comparative Analysis of Remedial Alternatives for Soils and Drums at Site 41 (continued)

Criterion	Alternative 1: No Action	Alternative 2: Institutional Controls	Alternative 3: Removal and Off-Site Incineration of Drums and Stained Soil	Alternative 4: Removal and Off-Site Disposal of Drums and Stained Soil
Reduction of Toxicity, Mobility, and Volume	There is no reduction of the toxicity, mobility, or volume of contaminants in the soil or in the drum contents through treatment under this alternative.	There is no reduction of the toxicity, mobility, or volume of contaminants in the soil or in the drum contents through treatment under this alternative.	Eliminates toxicity and mobility of contaminants through removal and off-site disposal by incineration. There is no reduction of waste volume under this alternative.	There is no reduction of the toxicity, mobility, or volume of contaminants in the soil or in the drum contents through treatment under this alternative.
Short-Term Effectiveness	There are no short-term hazards to human health or the environment associated with this alternative.	Health concerns are the construction hazards associated with installation of a fence or other barrier. Wildlife may be temporarily disturbed by the construction activities.	Health concerns are the physical hazards associated with the removal and off-site transport of the drums and soil. Wildlife may be temporarily disturbed during removal and shipment of the drums.	Health concerns are the physical hazards associated with the removal and off-site transport of the drums and soil. Wildlife may be temporarily disturbed during removal and shipment of the soil.
Implementability	No implementability concerns.	Readily implementable.	Readily implementable.	Readily implementable.
Cost	No cost.	Capital: \$19,500 O&M ^(e) /yr: \$500 PW ^(e) @ 5%: \$7,700 Total: \$27,200	Capital: \$222,000 O&M/yr: 0 Total: \$222,000	Capital: \$193,000 O&M/yr: 0 Total: \$193,000
State Acceptance	To be evaluated following regulatory review of this FS.	To be evaluated following regulatory review of this FS.	To be evaluated following regulatory review of this FS.	To be evaluated following regulatory review of this FS.

Table 6-7. Comparative Analysis of Remedial Alternatives for Soils and Drums at Site 41 (continued)

Criterion	Alternative 1: No Action	Alternative 2: Institutional Controls	Alternative 3: Removal and Off-Site Incineration of Drums and Stained Soil	Alternative 4: Removal and Off-Site Disposal of Drums and Stained Soil
Community Acceptance	To be evaluated during the public comment period that will follow release of the RI and FS reports to the community.	To be evaluated during the public comment period that will follow release of the RI and FS reports to the community.	To be evaluated during the public comment period that will follow release of the RI and FS reports to the community.	To be evaluated during the public comment period that will follow release of the RI and FS reports to the community.

^aARARs = Applicable or Relevant and Appropriate Requirements.

^bOSHA = Occupational Safety and Health Act.

^cO&M/yr = operation and maintenance per year.

^dPW = present worth.

6.1.13 Detailed Analysis of No-Action Alternative for Groundwater and Surface Water

Overall protection of human health and the environment. This alternative meets the remedial-action objective.

Compliance with ARARs. Drinking water MCLs are met by this alternative.

Long term effectiveness and permanence. This alternative would be protective of human health and the environment over the long term.

Reduction of toxicity, mobility, or volume through treatment. There is no reduction of toxicity, mobility, or volume of groundwater contaminants through treatment under this alternative.

Short-term effectiveness. There are no short-term hazards associated with this alternative.

Implementability. There are no implementability concerns associated with the no-action alternative.

Cost. There are no costs for this alternative.

State acceptance. This criterion will be evaluated following regulatory review of this FS.

Community acceptance. This criterion will be evaluated during the public comment period that will follow release of the RI and FS reports to the community.

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Appendix A

Location-Specific ARARs and Chemical Specific ARARs

The documents presented in this appendix represent a "generic" assessment of location-specific and chemical-specific ARARs pertinent to Tooele Army Depot, North and South Areas. These documents are draft in nature and were written approximately 2 years ago. Since regulations and program requirements have subsequently evolved, these documents are provided in this appendix to illustrate the basis for generating the formal list of ARARs (Table 1-1, Primary ARARs for TEAD-N) used in this Feasibility Study.

Apparent inaccuracies or deficiencies in the information contained in these documents of this appendix were evaluated against current regulations and program requirements and rectified prior to incorporation into this Feasibility Study and Table 1-1. Pertinent ARARs not included in these documents were also identified and incorporated into the Table 1-1, and other sections of this Feasibility Study. However, no attempt was made to modify the documents provided in this appendix during this Feasibility Study program. As such, the documents provided in this appendix are qualified by these conditions and by responses to comments presented by the Utah Division of Environmental Response and Remediation (UDERR).

**Assessment of Location-Specific ARARs
for Tooele Army Depot, North and South Areas**

**ASSESSMENT OF LOCATION-SPECIFIC APPLICABLE OR RELEVANT
AND APPROPRIATE REQUIREMENTS (ARARS) FOR
TOOELE ARMY DEPOT, NORTH AND SOUTH AREAS**

January 27, 1992

**CHEMICAL HAZARD EVALUATION PROGRAM
BIOMEDICAL AND ENVIRONMENTAL INFORMATION SECTION
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**ASSESSMENT OF LOCATION SPECIFIC APPLICABLE OR RELEVANT
AND APPROPRIATE REQUIREMENTS (ARARS) FOR
TOOELE ARMY DEPOT, NORTH AND SOUTH AREAS, UTAH**

1. INTRODUCTION

The Comprehensive Environmental Response, Compensation and Liability Act (CERCLA) of 1980 was passed by Congress and signed into law on December 11, 1980 (Public Law 96-510). This act was intended to provide for "liability, compensation, cleanup, and emergency response for hazardous substances released into the environment and cleanup of inactive waste disposal sites." The Superfund Amendments and Reauthorization Act (SARA), adopted on October 17, 1986 (Public Law 99-499), did not substantially alter the original structure of CERCLA, but provided extensive amendments to it.

In particular, § 121 of CERCLA specifies that remedial actions for cleanup of hazardous substances must comply with requirements or standards under federal or more stringent state environmental laws that are applicable or relevant and appropriate to the hazardous substances or circumstances at a site. Inherent in the interpretation of applicable or relevant and appropriate requirements (ARARs) is the assumption that protection of human health and the environment is ensured. The purpose of this report is to supply a preliminary list of available federal and state location-specific ARARs that might be considered for the Tooele Army Depot, North and South Areas (TEAD) in Utah.

Location-specific requirements "set restrictions upon the concentration of hazardous substances or the conduct of activities solely because they are in special locations" (53 FR 51394). In determining the use of location-specific ARARs for selected remedial actions at CERCLA sites, one must investigate the jurisdictional prerequisites of each of the regulations. Basic definitions, exemptions, etc., should be analyzed on a site-specific basis to confirm the correct application of the requirements.

The following is an explanation of the terms used throughout this report:

Applicable requirements are "those cleanup standards, standards of control, and other substantive environmental protection requirements, criteria, or limitations promulgated under federal or state law that specifically address a hazardous substance, pollutant, contaminant, remedial action, location, or other circumstances at a CERCLA site" (52 FR 32496, August 27, 1987).

Relevant and appropriate requirements are "those cleanup standards, standards of control, and other substantive environmental protection requirements, criteria, or limitations promulgated under federal or state law that, while not applicable to a hazardous substance, pollutant, contaminant, remedial action, location, or other circumstance at a CERCLA site, address problems or situations sufficiently similar to those encountered at the CERCLA site that their use is well suited to the particular site" (52 FR 32496).

Requirements under federal or state law may be either applicable or relevant and appropriate to CERCLA cleanup actions, but not both. However, requirements must be both relevant and appropriate for compliance to be necessary. In the case where both a federal and a state ARAR are available, or where two potential ARARs address the same issue, the more stringent regulation must be selected. However, CERCLA §121(d)(4) provides several ARAR waiver options that may be

invoked, providing that the basic premise of protection of human health and the environment are not ignored. A waiver is available for state standards that have not been uniformly applied in similar circumstances across the state. In addition, CERCLA §121(d)(2)(C) forbids state standards that effectively prohibit land disposal of hazardous substances.

CERCLA on-site remedial response actions must only comply with the substantive requirements of a regulation and not the administrative requirements to obtain federal, state, or local permits [CERCLA §121(e)]. In order to ensure that CERCLA response actions proceed as rapidly as possible, the EPA has reaffirmed this position in the final National Contingency Plan (NCP) (55 FR 8756, March 8, 1990). Substantive requirements pertain directly to the actions or conditions at a site, while administrative requirements facilitate their implementation. The EPA recognizes that certain of the administrative requirements, such as consultation with state agencies, reporting, etc., are accomplished through the state involvement and public participation requirements of the NCP. These administrative requirements should be observed if they are useful in determining cleanup standards at the site (55 FR 8757).

In the absence of federal- or state-promulgated regulations, there are many criteria, advisories, guidance values, and proposed standards that are not legally binding, but may serve as useful guidance for remedial actions. These are not potential ARARs but are "to-be-considered" (TBC) guidance. These standards, etc., may be addressed in the text of this report as deemed appropriate.

2. LOCATION-SPECIFIC ARARs

Table 1 lists the major federal and state location-specific ARARs that might be pertinent to remedial actions at both N-TEAD and S-TEAD.

2.1. Caves, salt-dome formations, salt-bed formations, underground mines

The area encompassing N-TEAD and S-TEAD is characterized by broad valleys separated by linear mountains (Christenson 1991a; Weston 1991). These facilities are located in the Tooele Valley and Rush Valley, respectively. The Oquirrh Mountains are to the east of both facilities with the Stansbury Mountains to the west of N-TEAD and the Onaqui Mountains to the west of S-TEAD (EESTI 1988a; EESTI 1988b; Weston 1991). There are no indications of salt-bed formations, salt-dome formations, caves or underground mines at either site (EESTI 1988a; EESTI 1988b; Christenson 1991a; Christenson 1991b; Weston 1991). There is a gold mine located approximately 4 miles from the northeastern boundary of S-TEAD (Woods 1992). Should any of these features be discovered on the installation, the provisions of 40 CFR 264.18(c) would become implicated.

2.2. Faults

Both N-TEAD and S-TEAD are located in the Great Basin section of the Basin and Range Geologic Province (EESTI 1988a). There are fault blocks/zones to the east, west and south of the installations (EESTI 1988a). The area has some history of seismicity (classified Building Code seismic zone 3) and is considered potentially active (Christenson 1991a; EESTI 1988a). There has been extensive movement along the faults in this region since the late Miocene Epoch (EESTI 1988a). There are no known faults on N-TEAD itself (EESTI 1988a; Christenson 1991a). However, there are faults in the vicinity of the installation, such as those associated with the Northern Oquirrh Fault Zone to the east, which are indicative of Holocene

TABLE 1. Tentative Location-Specific Applicable or Relevant and Appropriate Requirements for TEAD

Location Characteristic(s)	Operating Condition(s)	Requirement(s)	Citation(s)
<u>Faults</u>			
• With displacement in Holocene time.	<ul style="list-style-type: none"> • New treatment, storage or disposal facility. • RCRA^a-defined listed or characteristic hazardous waste (40 CFR 261) -or- RCRA- permitted facility. 	<ul style="list-style-type: none"> • Portions of new facilities must not be within 61 meters (200 feet) of such fault. 	<ul style="list-style-type: none"> • 40 CFR 264.18(a)
<u>Wetlands</u>			
• Presence of wetlands as defined in Executive Order 11990 § 7(c) and 40 CFR 6, Appendix A § 4(j).	<ul style="list-style-type: none"> • Agency action which involves: <ul style="list-style-type: none"> -acquiring, managing, and disposing of lands and facilities -providing federally undertaken, financed, or assisted construction and improvements -conducting federal activities and programs affecting land use. 	<ul style="list-style-type: none"> • Whenever possible, agency actions must avoid or minimize adverse impacts on wetlands and act to preserve and enhance their natural and beneficial values. Agencies should particularly avoid new construction in wetlands areas unless there are no practicable alternatives. • Agency shall incorporate wetlands protection considerations into planning, regulating, and decision-making processes. 	<ul style="list-style-type: none"> • Executive Order 11990 • 40 CFR 6.302(a) • 40 CFR 6, Appendix A
• Presence of wetlands as defined in 40 CFR 230.3(i) and 33 CFR 328.3(b).	<ul style="list-style-type: none"> • Agency action involving discharge of dredge or fill material into wetlands. 	<ul style="list-style-type: none"> • Agency must take action to avoid degradation of wetlands to the extent possible. Discharges for which there are practicable alternatives with less adverse impacts or those which would cause or contribute to significant degradation are prohibited. • If adverse impacts are unavoidable, the agency must take action to enhance, restore, or create alternative wetlands. 	<ul style="list-style-type: none"> • Clean Water Act § 404 • 40 CFR 230 • 33 CFR 320-330
<u>Archaeologic and historic resources</u>			
• Presence of archaeological resources on public land.		<ul style="list-style-type: none"> • Agency must take steps to protect archaeological resources and sites. 	<ul style="list-style-type: none"> • Archaeological Resources Recovery Act of 1979 (16 USC 470aa-ll) • 43 CFR 7

TABLE 1. (Continued)

Location Characteristics(s)	Operating Condition(s)	Requirement(s)	Citation(s)
• Presence of archaeological or historical materials.	• Agency action involving dam construction or other alteration of terrain which might cause irreparable loss or destruction of significant scientific, prehistoric, historic, or archaeological data.	• Agency must advise Secretary of Interior of presence of the data. • Agency must conduct survey of affected areas for resources and data and must take steps to recover, protect, and preserve data therefrom or request that DOI ⁶ do so.	• Archaeological and Historical Preservation Act (16 USC 469a-c) • 40 CFR 6.301
• Presence of federally owned, administered, or controlled prehistoric or historic resources or likelihood of undiscovered resources.		• Agency must identify cultural resources included on, or eligible for, inclusion on the National Register of Historic Places (36 CFR 60) or National Historic Landmark Program (36 CFR 65). • Agency must identify whether agency action(s) will affect such resources and, if so, must examine and consider alternatives to the action(s). • When alteration or destruction of the resource is unavoidable, agency must take steps to minimize or mitigate the impacts and to records and data of the resource. • When all or part of a remedial action is off-site, the consultation requirements of 16 USC 470f must be completed. • Consultation is also strongly recommended for on-site actions.	• National Historic Preservation Act (16 USC 470a-w) • Executive Order 11593 • 40 CFR 6.301 • 36 CFR 800
• Presence of sites or artifacts which are associated with current Indian, or other traditional, religious practices, rites, or ceremonies.	• Agency action which would threaten the inherent religious qualities or use associated with the site or artifacts or which would limit access thereto.	• Agency must consider the sacred or religious character of the site or artifact and its relationship to Indian or traditional freedom of religion. • Consultation with Indian or traditional native religious leaders is required for off-site actions and impacts. • Consultation is also strongly recommended for on-site actions and may be legally required for compliance with the intent of the American Indian Religious Freedom Act to protect First Amendment rights.	• American Indian Religious Freedom Act (42 USC 1996) • 43 CFR 7

TABLE 1. (Continued)

Location Characteristic(s)	Operating Condition(s)	Requirement(s)	Citation(s)
<u>Endangered, threatened, or rare species</u>			
• Presence of endangered or threatened species -or- critical habitat of such species as designated in 50 CFR 17, 50 CFR 226, or 50 CFR 227.	• Agency action which is likely to jeopardize species or destroy or adversely modify critical habitat.	<ul style="list-style-type: none"> • Agency must avoid actions which jeopardize species/habitat or take appropriate mitigation measures. • Off-site actions which affect species/habitat require consultation with DOI, FWS^c, NMFS^d, and/or state agencies, as appropriate, to ensure that proposed actions do not jeopardize the continued existence of the species or adversely modify or destroy critical habitat. • Consultation is also strongly recommended for on-site actions. 	<ul style="list-style-type: none"> • Endangered Species Act of 1973 (16 USC 1531 <i>et seq.</i>) • 50 CFR 402 • 40 CFR 6.302(h) • Fish and Wildlife Coordination Act (16 USC 661 <i>et seq.</i>)
• Presence of endangered or threatened species or critical habitat (see above citation) of same within an aquatic ecosystem as defined in 40 CFR 230.3(c).	• Agency action involving discharge of dredge or fill material into aquatic ecosystem.	<ul style="list-style-type: none"> • Agency shall not discharge dredge or fill material into an aquatic ecosystem if it would jeopardize such species or would likely result in the destruction or adverse modification of a critical habitat of the species 	<ul style="list-style-type: none"> • Clean Water Act § 404 • 40 CFR 230.10(b)

^aRCRA = Resource Conservation and Recovery Act; definitions appear at 40 CFR 260.10.

^bDOI = Department of Interior

^cFWS = Fish and Wildlife Service

^dNMFS = National Marine Fisheries

(Post Lake Bonneville) displacement (Christenson 1991a). In addition, much of S-TEAD is located on a geological feature known as the Mid-Valley Horst (Weston 1991). A Holocene fault associated with this feature runs north-south near the center of S-TEAD across the ammunition storage area and igloo area 9 (Weston 1991).

The RCRA seismic requirements for locations of treatment, storage, and disposal (TSD) facilities [40 CFR 264.18(a)] are considered ARARs for CERCLA remedial actions. Under those regulations Tooele County, Utah is one of the jurisdictions that must demonstrate compliance with requirements prohibiting such facilities within 61 meters (200 feet) of a fault with Holocene displacement (40 CFR 264.18 and Appendix IV). The Utah requirements [Utah Administrative Code (UAC) R450-8.2.9] are identical to the federal requirements in this regard. These requirements would be ARARs for any TSD facilities constructed on S-TEAD as part of the remedial process. In addition, the EPA does intend to propose additional seismic restrictions for the location of TSD facilities (NPRM March 1992; Final Rule expected March 1994). At that time, the new regulations may also become applicable to these locations.

← no fault
on TEAD -

2.3. Wilderness areas, wildlife refuges, wildlife resources, scenic rivers

There are no wilderness areas or scenic rivers on or near N-TEAD or S-TEAD. However, Utah has created the Pony Express Wildlife Management Area on Faust Creek on the southern boundary of S-TEAD. The area is a Utah state designated wetlands and waterfowl management area (Shirley 1991). Should any remedial action impacts extend to this area, the Utah Department of Wildlife Resources - Central Region in Springville, Utah should be consulted as regards any regulations that might be applicable or TBC.

2.4. Wetlands and floodplains

There are no perennial streams or rivers on N-TEAD, although the reaches of several streams flow just to the south and southwest of the installation (EESTI 1988a; U.S. Army 1991). Box Elder Wash traverses N-TEAD from the southwestern corner to the north-central boundary (Woods 1992). There are no documented floodplains on N-TEAD (Carter 1991; Anderson 1989). Some information also indicates that there are no wetlands at the site (EESTI 1988a; Weder 1991a). However, the National Wetlands Inventory (NWI) map for the installation shows a number of wetlands at N-TEAD, possibly associated with the sewage lagoons (U.S. Army 1991). It must be remembered that the NWI maps are compiled from high altitude photographs and are not purported to be absolutely accurate (Carter 1991). In addition, it is not clear whether the wetlands that appear on the NWI maps meet the jurisdictional definition of wetlands required by the statutes and regulations that would apply to such resources (U.S. Army 1991).

Although there are no perennial streams or rivers on S-TEAD, there are numerous intermittent streams that traverse the site, including Faust Creek and Ophir Creek (Weston 1991). Although no surveys are available at this time, there are indications that there may be wetlands on the site. Utah has created a Wetlands Management Area on Faust Creek, approximately 2 miles from the southern boundary of the site (Johnson, C. 1991; Weston 1991). Although there has been no formal designation, the U.S. Bureau of Land Management has developed a wetlands management area adjacent to the north central boundary of S-TEAD, which is fed by water that flows through the site in Faust Creek (Hedrick 1991). In addition, there is a surface water impoundment along the western boundary, which has been observed to form a shallow lake of several hundred acres during spring snow melt and rainy periods (Weston 1991). The water from this impoundment eventually drains to the north through Rush Valley to Rush Lake (EESTI

1988b). There is no information available as to whether this feature would fit the jurisdictional definition of wetlands.

Floodplain maps for the S-TEAD area are currently being compiled, but are not available at this time (Johnson, 1991). The level of the 100-year floodplain has not been designated for this area (Harvey 1991). There apparently were some flooding, or water control problems, during the spring of 1983 and the spring of 1984 (Johnson, R. 1991)

Given the ambiguity and conflicting information regarding the presence of these resources, a comprehensive wetlands survey of both parts of TEAD is advisable. If wetlands that meet the jurisdictional definitions are present at the site, or would be impacted by any remedial actions, then the provisions of various laws and regulations may be ARARs for remedial actions: Executive Order 11990; 40 CFR 6 (Appendix A); 40 CFR 6.302(a); Clean Water Act § 404; 40 CFR 230; and 33 CFR 320-330. If floodplains are identified at S-TEAD, 40 CFR 264.18(b), Executive Order 11988, 40 CFR 6.302(b) and 40 CFR 6 (Appendix A) would be applicable to any remedial action that impacts those resources. In addition, the EPA does intend to propose additional floodplain restrictions for the location of TSD facilities (NPRM March 1992; Final Rule expected March 1994).

2.5. Archaeological resources and historic sites

In 1984, a report was prepared for the U. S. Department of Interior on the potential historic buildings at TEAD (Building Technologies, Inc. 1981). However, it is not clear whether all the structures on the depot were surveyed or identified (Schirer 1989). The conclusion, at the time of the report, was that none of the buildings at the installation were of "archaeological, historical or technological significance" (Building Technologies, Inc. 1984). There has been no systematic survey of the installation for archaeological resources (Weder 1991a). Preliminary indications from rudimentary surveys done for other purposes at the installation have indicated that there are, indeed, archaeological and historic resources present (Weder 1991a).

A petroglyph, which may be eligible for the National Register of Historic Places (36 CFR 60), has been located in the northeastern portion of N-TEAD (Weder 1991a; EESTI 1988a). There is additional evidence of prehistoric habitation near the western boundary of N-TEAD (Weder 1991a). There are also structures there that apparently date from the prehistoric Fremont period and are associated with a Fremont community on South Willow Creek (EESTI 1988a). Finally, a prehistoric campsite has been tentatively identified at the TNT Washout Lagoon at N-TEAD (Weder 1991a).

At S-TEAD, a prehistoric camp site was located in the central region of that site, to the east of the Chemical Agent Storage Area (Weder 1991b). In addition, an old homestead and trash dump containing late 19th and early 20th century artifacts is located south of the main entrance (Weder 1991b). A cemetery is also located in the north central part of S-TEAD (EESTI 1988b).

Before any remedial actions are undertaken at the depot, a systematic survey of the historic and archaeological resources should be undertaken. The National Historic Preservation Act of 1966 (16 USC 470 *et seq.*) mandates that federal agencies have a positive duty to "locate, inventory, and nominate" properties under their control that are eligible for the National Register. Properties that are eligible for the Register are protected under the Act, whose provisions would be ARAR for remedial actions at N-TEAD. Similarly, the Archaeological Resources Protection

Act of 1979 (16 USC 470aa-11) creates positive duties for federal agencies with regard to identifying and protecting archaeological resources. Its substantive provisions would be applicable to remedial actions at N-TEAD. In addition, the provisions of 16 USC 469a-1, 36 CFR 800, 36 CFR 65 and Executive Order 11593 may also apply.

2.6. Rare, threatened, or endangered species

Both the bald eagle (*Haliaeetus leucocephalus*) and the peregrine falcon (*Falco peregrinus*), which are federal endangered species, are known to occur on, or in the vicinity of N-TEAD (U.S. Army 1991; EESTI 1988a). The bald eagle uses S-TEAD as a feeding area and the area encompassing both S-TEAD and N-TEAD is considered important habitat for the species (Weder 1991a; U.S. Army 1991; EMD Memo 1991; EESTI 1988a). In addition, nesting pairs of the long billed curlew (*Numenius americanus*), a federal candidate species, were noted along the western boundary of S-TEAD in 1991 (EMD Memo 1991). Another federal candidate species, the ferruginous hawk (*Buteo regalis*), was also sighted on S-TEAD in 1991 (EMD Memo 1991). Additionally, there are a number of other federal candidate and state sensitive species that are potentially present at TEAD, although there have been no specific sightings (EMD Memo 1991). For a list of these species and relevant habitat information please see the Environmental Management Division Memorandum of August 15, 1991, cited herein as EMD Memo 1991.

There are apparently no endangered plant species on the installation, although two federal candidate species, Ute's lady's tresses (*Spiranthes diluvialis*) and *Cryptantha compacta* may possibly occur (EMD Memo 1991; U.S. Army 1991; EESTI 1988a). However, there has been no inventory of the installation and it is suggested that this be done before any remedial actions are taken.

Should remedial actions affect any endangered or threatened species or their critical habitat, ARARs could derive from the Endangered Species Act of 1973 (16 USC 1531 *et seq.*), 50 CFR 402, 40 CFR 6.302(h), and the Fish and Wildlife Coordination Act (16 USC 661 *et seq.*). The Utah state endangered species list for animals encompasses those species on the federal list (Quinn 1991). The plant list is maintained by the Utah Heritage Program and is not a part of Utah state laws or regulations per se (Quinn 1991). However, the Utah Division of Wildlife Resources normally consults with any federal or state agency whose actions may threaten or adversely affect not only threatened or endangered species, but any other species of concern at a given location (Quinn 1991). Such consultation would be mandatory for off-site actions or impacts and is strongly recommended for on-site actions that affect the indigenous animal populations. Correspondingly, the Utah Heritage Program should be consulted regarding potential disturbance of plant species.

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**Assessment of Chemical-Specific ARARs
for Tooele Army Depot, North and South Areas**

**ASSESSMENT OF CHEMICAL-SPECIFIC APPLICABLE OR
RELEVANT AND APPROPRIATE REQUIREMENTS (ARARS) FOR
TOOELE ARMY DEPOT, NORTH AND SOUTH AREAS, UTAH**

DRAFT REPORT

August 25, 1992

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ASSESSMENT OF APPLICABLE OR RELEVANT AND APPROPRIATE REQUIREMENTS (ARARS) FOR TOOEELE ARMY DEPOT, NORTH AND SOUTH AREAS, UTAH

1. INTRODUCTION

The Comprehensive Environmental Response, Compensation and Liability Act of 1980 (CERCLA) was passed by Congress and signed into law on December 11, 1980 (Public Law 96-510). This act was intended to provide for "liability, compensation, cleanup, and emergency response for hazardous substances released into the environment and the cleanup of inactive waste disposal sites." The Superfund Amendments and Reauthorization Act (SARA), adopted on October 17, 1986 (Public Law 99-499), did not substantially alter the original structure of CERCLA but provided extensive amendments to it.

In particular, Title I, § 121 of SARA specifies that for any hazardous substance, pollutant, or contaminant that remains on-site, the level or standard of control that must be met shall be at least that of any legally applicable or relevant and appropriate regulation (ARAR), standard, criteria, or limitation under any federal environmental law or any more stringent standard promulgated under state environmental or facility siting law. Inherent in the interpretation of ARARs is the assumption that protection of human health and the environment is ensured.

The U.S. Army Toxic and Hazardous Materials Agency (USATHAMA) has asked the support of the Chemical Hazard Evaluation Group in the Health and Safety Research Division at Oak Ridge National Laboratory (ORNL) for assistance in determining ARARs for Tooele Army Depot (TEAD) - North and South Areas, Tooele, Utah. The North Area (TEAD-N) is currently listed on the National Priorities List (NPL) (52 FR 27620, July 22, 1987) due to contamination at the old TNT washout evaporation/percolation (E/P) ponds. Supporting documentation for this report includes the TEAD Installation Assessment (USATHAMA 1979), the TEAD Preliminary Assessment/Site Investigation (PA/SI) - Volume I North Area and Facilities at Hill Air Force Base (EESTI 1988), and the Final Draft Report of Remedial Investigation for Tooele Army Depot - North Area (Weston 1990). A RCRA Phase I RFI has been conducted for the South Area (TEAD-S) (Ebasco 1992) as a requirement of Module VII - Corrective Action for Solid Waste Management Units (SWMUs) in TEAD-S, Chemical Stockpile Disposal Plant Permit.

TEAD is situated in the Great Basin Section of the Basin and Range Physiographic Province in west central Utah. TEAD is bounded on the east by the Oquirrh Mountains and on the west by the Stansbury Mountains. Undeveloped areas immediately adjacent to TEAD are used for pasture, rangeland grazing, and cultivation. Mining of metals has occurred in the Oquirrh Mountains and Mercur Creek (north of TEAD-S) for several years. The North Area is situated on the desert floor of the Tooele Valley. The North Area encompasses 10,007 hectares and is located approximately 57 km southwest of Salt Lake City, Utah. The facility has operated as a supply depot providing for receipt, storage, issue, maintenance, and disposal of assigned commodities, including ammunition, combat vehicles, bulk chemical agents and chemical weapons. After World War II, the mission was expanded to include the support of other Army installations in the western U.S. (USATHAMA 1979). TEAD-S encompasses 19,355 acres and is located in a separate valley, Rush Valley, approximately 17 miles south of TEAD-N and 35 miles southwest of

Salt Lake City. The primary mission of the facility is that of storage and maintenance of bulk chemical agents and chemical weapons (Ebasco 1992).

There are no permanent streams or rivers in either the North or South Areas of TEAD. All streambeds within the depot boundaries carry intermittent flow, which is primarily runoff from mountain snowmelt. The primary intermittent creeks in TEAD-N are South Willow Creek and Box Elder Wash and the primary intermittent systems entering TEAD-S are Ophir Creek, Mercur Creek, and Faust Creek. Water from these streams is either diverted for irrigation, infiltrated to the groundwater, or lost by evapotranspiration. Any generated drainage from the North Area moves north toward the Great Salt Lake. A small amount of the surface water in the South Area reaches Rush Lake at the northern boundary of the valley where it is evaporated. The State of Utah, under Utah Administrative Code (UAC) R317-2-13, has classified Ophir Creek as "3A" for the protection of cold water species of game fish and other cold water aquatic life, including the necessary aquatic organisms in their food chains and as "4" for the protection of agricultural uses, including irrigation and watering of stock. Rush Lake is designated "2B" for protection of boating, water skiing and similar uses (excluding swimming) and "3B" for protection of warm water species of game fish and other warm water aquatic life, including necessary aquatic organisms in their food chains. The Great Salt Lake is classified as "6" for waters requiring protection when conventional uses as identified in other classes do not apply. However, due to the intermittent nature of the surface waters at TEAD-N and TEAD-S, the systems are not hydrologically connected to any waste ponds, lagoons, ditches, or craters and thus, are not impacted. Consequently, no ARARs develop for this media and associated sediments. Significant contamination in the waters and sediments of the waste ponds and lagoons at these sites will be addressed during remediation of the sites.

The principal aquifer at TEAD is in the granular strata within the valley fill. Groundwater recharge is primarily via infiltration of mountain streams and precipitation within the drainage basin. Groundwater flow generally follows ground contours north toward Great Salt Lake, which is the major discharge area for the regional groundwater system at TEAD. A regional divergence occurs in Rush Valley, with the groundwater in the southeastern portion of TEAD-S flowing south and east. Groundwater in the aquifer underlying TEAD-N at depths between 103 and 190 meters supplies domestic water to six wells in the North Area and to the towns of Grantsville, Erda, and Tooele (USATHAMA 1979). There are also two active potable wells in the northeast corner of TEAD-S.

During a Preliminary Assessment/Site Investigation (PA/SI) for TEAD-N, EESTI (1988) investigated 19 sites on-post and 3 sites off-post as potential sources of environmental contamination. Four sites [TNT Washout Facility Area, Former Transformer Storage Area, PCB Spill Site, Open Burn/Open Detonation (OB/OD) Grounds] were considered to present a significant potential threat to human health and the environment. Sampling results indicated that no threat was posed at the Transformer Storage Area, the PCB Spill Site, or the OB/OD Grounds; however, significant contamination of the soils and groundwater had occurred at the TNT Washout Facility Area from leaching of explosives from the sediments of the TNT Washout Ponds and seepage of effluent from the Laundry Effluent Pond. It was determined that 14 sites on-post and 1 site off-post were not posing a threat to human health and the environment. Further investigations were recommended for 7 on-post sites (Barrel Storage Area, Sewage Lagoon, Munition Sawing Site, Chemical Range, Surveillance Test Site, X-Ray Lagoon, and Sanitary Landfill) and for 2 off-post sites (Bauer Mine Trailings Site and Anaconda Deep Mine

Site). Subsequently, Weston (1990) conducted a Remedial Investigation for TEAD-N focusing on five areas that were identified in the previous investigations as potential sources of contamination: 1) TNT Washout Facility, 2) Sanitary Landfill, 3) Drum Storage Areas, 4) Old Burn Area, and 5) Chemical Range. The purpose of the RI was to better define the contamination at the TNT Washout Facility and to determine the extent of contamination at the other areas. Weston (1990) concluded that site-related contamination by explosives had occurred in the subsurface soils, shallow perched groundwater, and regional aquifer at the TNT Washout Facility and that contamination by metals and volatile organic compounds (VOCs) had occurred in the regional aquifer underlying the Sanitary Landfill. Soil contamination by polynuclear aromatic hydrocarbons (PAHs) was detected in surface soils at the Drum Storage Area. Metals were also detected in the groundwater at this site at concentrations exceeding background. Sampling was hampered at the Old Burn Area and the Chemical Range due to the presence of unexploded ordinance; however, metals were detected in surface soils at the Chemical Range at concentrations exceeding background levels. Remediation of the groundwater and soils at the TNT Washout Facility was recommended (Weston 1990).

Ebasaco (1992) conducted a Phase I RCRA Facility Investigation (RFI) at TEAD-S to identify the presence or absence of contamination at 27 suspected releases solid waste management units (SWMUs) and at 8 meteorological stations. The SWMUs are primarily munitions disposal, storage, and washout areas. Results of the RFI indicate that there was no contamination at 6 SWMUs and additional interim sampling was required at 10 SWMUs to determine if a Phase II study is needed. Phase II RFI studies were recommended for 9 SWMUs (# 1&4, 3, 5, 8, 9, 25, 30, 31, and 37) based on explosives contamination in the groundwater and soils from the munitions burning and burial pits and heavy metals and VOC contamination in the soils at some SWMUs. There does not appear to be widespread groundwater contamination in plumes at the site.

2. SELECTION OF ARARs

Selection of ARARs is dependent on the hazardous substances present at the site, the site characteristics and location, and the actions selected for a remedy. Thus, these requirements may be chemical-, location-, or action-specific. Chemical-specific ARARs are health- or risk-based concentration limits set for specific hazardous substances, pollutants, or contaminants. Location-specific ARARs address such circumstances as the presence of an endangered species on the site or the location of the site in a 100-year floodplain. Location-specific ARARs have been provided under separate cover. Action-specific ARARs control or restrict particular types of remedial actions selected as alternatives for cleanup of the site.

2.1. CHEMICAL-SPECIFIC ARARs

The Superfund human health evaluation process, which is conducted during the RI/FS, is composed of three phases: 1) the baseline risk assessment, 2) the refinement of preliminary remediation goals, and 3) remedial alternatives risk evaluation. The process is fully described in the USEPA Risk Assessment Guidance for Superfund, Volume I: Human Health Evaluation Manual (RAGS) (USEPA 1989). The first step in the baseline risk assessment at Superfund sites is data collection and evaluation, which involves the selection of chemicals of concern (COCs) or "indicator chemicals". This procedure identifies the chemicals that pose the greatest potential public health risk at a site and is based on site monitoring data, chemical toxicity information in

the form of toxicity factors developed by EPA, and environmental persistence and mobility of the chemicals.

Chemical-specific ARARs or "to be considered" (TBC) guidance values are subsequently selected to set protective cleanup levels for the chemicals of concern in the designated media or else indicate a safe level of discharge that may be incorporated when considering a specific remedial activity.

2.1.1. Chemicals of Potential Concern

We have developed the list of chemicals of potential concern for the North and South Areas of TEAD following the guidelines outlined in Chapter 5 of RAGS (USEPA 1989). Initially, a concentration-toxicity screening procedure, as outlined in RAGS, was used to obtain a ranking of the relative risk for each detected chemical in a specific medium. A microcomputer-based spreadsheet was used to automate the routine features of the procedure (CASIC). A risk factor for each chemical detected in a medium was calculated as the maximum detected concentration times a toxicity factor, which is the inverse of the reference dose (RfD) for noncarcinogens or the carcinogen potency factor (CPF) for carcinogens. The total risk factor for each medium is determined as the sum of the individual risk factors for each chemical detected in the medium. Subsequently, the relative risk for each chemical is the ratio of the individual chemical risk factor to the total risk factor in that medium. The most current toxicity factors used to derive the risk factor for each chemical were obtained from the EPA Integrated Risk Information System (IRIS) (USEPA 1992a) and/or the EPA Health Effects Assessment Summary Tables (USEPA 1992b). The "indicator" chemical worksheets, which show the calculation of the risk factors and relative risks for each chemical in each media, are presented in Appendix A for TEAD-N and in Appendix B for TEAD-S.

The top-scoring chemicals in the screening procedure, along with any detected chemicals for which toxicity factors are currently unavailable, were subsequently analyzed to establish a list of the chemicals posing the most significant health risks at the site. Final selection of COCs was based on evidence of human carcinogenicity, frequency of occurrence in environmental media, exceedance of acceptable intake values, exceedance of background levels, and environmental persistence and mobility.

Complete historical monitoring data for groundwater and soil at TEAD were obtained from the Installation Restoration Data Management System maintained at USATHAMA. All monitoring data have been quality assurance/quality control validated by USATHAMA (USATHAMA 1990). A total of 59 chemicals was detected in groundwater and/or soil samples obtained from TEAD-N during 1982 and from 1986 to 1990. A total of 117 chemicals was detected in groundwater and soil samples obtained from TEAD-S during 1982, 1987, 1988, 1990, and 1991.

2.1.1.1. Chemicals of Concern for TEAD-N

Potential carcinogens (13) and noncarcinogens (28) were ranked by relative risk, and a total of 16 COCs were selected from the top-ranking compounds in both toxicologic classes. Eight additional chemicals (benzo[a]anthracene, benzo[b]fluoranthene, chloride, chrysene, lead, sulfate, thallium, and trichloroethylene) for which toxicity constants are currently unavailable were

also selected. A list of the chemicals of potential concern selected for TEAD-N and supporting data is presented in Table 1. Table 2 lists chemicals with Maximum Contaminant Levels (MCLs) or proposed MCLs that were not selected as COCs for TEAD-N, primarily because the maximum detected concentration did not exceed the MCL.

Groundwater. The primary contaminants in groundwater were metals, VOCs, nitroaromatics and anions. Table 3 lists the range of concentrations, frequency of detection, certified reporting limits, and background levels for the groundwater contaminants selected for TEAD-N. Selection was based on site-related occurrence; maximum concentrations in exceedance of MCLs, proposed MCLs, or other health-based guidance values (see Table 9 for MCLs and TBC values); or potential toxicity based on relative risk ranking in CASIC. Of the chemicals selected, arsenic and benzene are classified by EPA as Group A known human carcinogens by either the oral or inhalation routes, and chromium VI is classified as Group A via inhalation. However, chromium was selected based on its systemic toxicity, not carcinogenicity.

2,4-Dinitrotoluene, RDX, and bis(2-ethylhexyl) phthalate presented approximately 96% of the carcinogenic risk to human health from groundwater contamination at the site. Approximately 98% of the noncarcinogenic risk to human health, as calculated in CASIC, can be attributed to nitrite and 1,3,5-trinitrobenzene.

Soil. The primary contaminants selected for soils at TEAD-N were metals, nitroaromatics, and polynuclear aromatic hydrocarbons. Table 4 presents information concerning the range of detected concentrations, frequency of detection, certified reporting limits, and background values for soil COCs at TEAD-S. Selection of soil COCs for TEAD-N was based on exceedance of background levels for Tooele County, exceedance of RCRA action levels, site-related occurrence, and potential toxicity based on relative risk ranking in CASIC. Maximum detected concentrations of chromium, nickel, and zinc were several times greater than background levels (see Table 4). 2,4,6-Trinitrotoluene presented 99.6% of the carcinogenic risk and 100% of the noncarcinogenic risk to human health, occurring at a maximum concentration of 3,202,500 mg/kg in boring TNT-4 at the TNT Washout Facility. Four PAHs (benzo[a]pyrene, benzo[a]anthracene, benzo[b]fluoranthene, and chrysene) were selected based on their occurrence in soils at the Drum Storage Area and their carcinogenic potential.

2.1.1.2. Chemicals of Concern for TEAD-S

Potential carcinogens (27) and noncarcinogens (47) were ranked by relative risk, and a total of 38 COCs were selected from the top-ranking compounds in both toxicologic classes. Ten additional chemicals (copper, gross alpha, gross beta, isopropylmethyl phosphonic acid, lead, sulfate, thallium, total petroleum hydrocarbons, trichloroethylene, and uranium) for which toxicity constants are currently unavailable were also selected. A list of the chemicals of potential concern selected for TEAD-S and supporting data is presented in Table 5. Table 6 lists chemicals with Maximum Contaminant Levels (MCLs) or proposed MCLs that were not selected as COCs for TEAD-S, primarily because the maximum detected concentration did not exceed the MCL.

Groundwater. The primary contaminants in groundwater were metals, VOCs, nitroaromatics, anions, and radionuclides. Table 7 lists the range of concentrations, frequency of detection, certified reporting limits, and background levels for the groundwater contaminants selected for TEAD-S. Of the chemicals selected, arsenic and benzene are classified by EPA as Group A

TABLE 1. CHEMICALS OF POTENTIAL CONCERN SELECTED FOR TEAD-N

Chemical	Groundwater			Soil		
	Maximum Concentration (mg/L)	Toxicologic Class ^a	Relative Risk Ranking	Maximum Concentration (mg/kg)	Toxicologic Class ^a	Relative Risk Ranking
<u>Metals</u> Arsenic	0.110	NC	3	—	—	—
Beryllium	—	—	—	3.00	PC NC	5 15
Chromium	0.0519	NC	10	217.71	NC	5
Lead	0.070	NA	NA	200.0	NA	NA
Nickel	0.294	NC	8	81.92	NC	10
Thallium	0.0034	NA	NA	—	—	—
Zinc	2.436	NC	9	2,072	NC	9
<u>Organic</u> Benzene	0.0016	PC	6	—	—	—
Bis(2-ethylhexyl)phthalate	0.790	PC NC	3 6	—	—	—
Trichloroethylene	0.0476	NA	NA	—	—	—
<u>Anions</u> Chloride	395.42	NA	NA	—	—	—
Nitrite/Nitrate	3,050	NC	1	—	—	—
Sulfate	1,842	NA	NA	—	—	—

TABLE 1. (CONT.)

Chemical	Groundwater			Soil		
	Maximum Concentration (mg/L)	Toxicologic Class ^a	Relative Risk Ranking	Maximum Concentration (mg/kg)	Toxicologic Class ^a	Relative Risk Ranking
<u>Nitroaromatics</u> 2,4-Dinitrotoluene	0.200	PC	1	80.0	PC	4
2,6-Dinitrotoluene	—	—	—	200.0	PC	2
HMX	0.0232	NC	17	95.2	NC	12
RDX	0.275	PC NC	2 4	1,000	PC NC	3 3
1,3,5-Trinitrobenzene	0.10	NC	2	90.0	NC	2
2,4,6-Trinitrotoluene	0.0374	PC NC	5 5	3,202,500	PC NC	1 1
<u>Polynuclear Aromatic Hydrocarbons</u> Benzo[<i>a</i>]anthracene	—	—	—	0.50	NA	NA
Benzo[<i>b</i>]fluoranthene	—	—	—	0.60	NA	NA
Benzo[<i>a</i>]pyrene	—	—	—	0.66	PC	6
Chrysene	—	—	—	1.65	NA	NA

^aPC = potential carcinogen; NC = noncarcinogen; NA = not available

TABLE 2. CHEMICALS WITH MCLS THAT WERE NOT SELECTED
AS CHEMICALS OF POTENTIAL CONCERN FOR TEAD-N

Chemical	MCL ($\mu\text{g/L}$) ^a	Maximum Concentration ($\mu\text{g/L}$)
Barium	2,000	488
Beryllium	4	1.6
Copper	1,300 ^b	216.5
<i>trans</i> -1,2-Dichloroethylene	100	11.2
Fluoride	4,000	1,000
Mercury	2	0.2
Nitrate	10,000	1,000
Selenium	50	8.8
Silver	50 ^c	2.6
Tetrachloroethylene	5	1.1
Toluene	1,000	13

^a Federal Safe Drinking Water Act (SDWA) maximum contaminant level (MCL).

^b Properly termed an "action level," not an MCL, under the federal SDWA (56 *FR* 26460, June 7, 1991; effective December 7, 1992), exceedence of this level triggers initiation of corrosion control studies and treatment requirements.

^c State MCL; the federal MCL for silver has been revoked, effective July 30, 1992 (56 *FR* 3526, January 30, 1991).

TABLE 3. RANGE OF CONCENTRATIONS, FREQUENCY OF DETECTION,
CERTIFIED REPORTING LIMIT, AND BACKGROUND LEVELS FOR
GROUNDWATER CHEMICALS OF CONCERN AT TEAD-N^a

Chemical	Range of Detected Concentrations ^b	Frequency of Detection	Certified Reporting Limit ^c	Background Levels ^d
Arsenic	5.2-110.0	38.0	5.0	<10.0
Benzene	0.85-1.62	10.0	NA	1.62
Bis(2-ethylhexyl)phthalate	10.0-790.0	23.1	10 (TRL)	57.0
Chloride	1,000-395,421	100.0	125,000 (TRL)	NA
Chromium	5.0-51.4	35.0	37.5	<10.0
2,4-Dinitrotoluene	7.5-200.0	4.1	0.6	ND
HMX	12.2-23.2	10.7	1.30	ND
Lead	2.3-70.0	59.0	1.78	3.44
Nickel	5.0-294.1	38.1	9.6	<40
Nitrite/Nitrate	520-3,050,000	88.5	500 (TRL)	5.0
RDX	1.0-275.0	27.8	0.63	ND
Sulfate	1,000-1,841,842	97.0	125,000 (TRL)	186-268
Thallium	3.4	3.6	5.0	<10.0
Trichloroethylene	1.11-47.6	14.8	0.71	ND
1,3,5-Trinitrobenzene	100.0	3.4	0.56	ND
2,4,6-Trinitrotoluene	1.0-37.4	13.5	0.78	ND
Zinc	16.0-16.2	100.0	17.2	41.3

^aAll values given in µg/L.

^bIRDMS, data printout March 1992.

^cAs reported in Weston 1990 (TRL = USATHAMA Target Reporting Limit).

^dAs reported in Weston 1990.

ND = not detected

NA = not available

TABLE 4. RANGE OF CONCENTRATIONS, FREQUENCY OF DETECTION, CERTIFIED REPORTING LIMIT, AND BACKGROUND LEVELS FOR SOIL CHEMICALS OF CONCERN AT TEAD-N^a

Chemical	Range of Detected Concentrations ^b	Frequency of Detection	Certified Reporting Limit ^c	Background Levels ^d
Benzo[a]anthracene	0.06-0.5	7.9	0.3 (TRL)	NA
Benzo[a]pyrene	0.44-0.66	5.3	0.3 (TRL)	NA
Benzo[b]fluoranthene	0.22-0.6	5.3	0.3 (TRL)	NA
Beryllium	0.3-3.0	21.1	0.33	ND
Chromium	3.6-217.7	82.2	2.5	30.0
Chrysene	0.41-1.65	7.9	0.3 (TRL)	NA
2,4-Dinitrotoluene	0.51-80.0	3.1	0.42	ND
2,6-Dinitrotoluene	300.0	0.5	0.40	ND
HMX	1.28-95.2	7.5	1.27	ND
Lead	6.33-200.0	38.9	4.78	15-70
Nickel	5.0-81.9	67.3	4.8	7-15
RDX	1.67-1,000	10.6	0.98	ND
1,3,5-Trinitrobenzene	3.51-90.0	13.4	2.09	ND
2,4,6-Trinitrotoluene	2.26-3,202,500	9.7	1.92	ND
Zinc	1.0-2,072	24.7	52.0	40-80

^aAll values are given in mg/kg (ppm).

^bIRDMS, data printout March 1992.

^cAs reported in Weston 1990 (TRL = Target Reporting Limit).

^dAs reported in Weston 1990.

NA = not available

ND = non-detected

TABLE 5. CHEMICALS OF POTENTIAL CONCERN SELECTED FOR TEAD-S

Chemical	Groundwater			Soil		
	Maximum Concentration (mg/L)	Toxicologic Class ^a	Relative Risk Ranking	Maximum Concentration (mg/kg)	Toxicologic Class ^a	Relative Risk Ranking
<u>Metals</u>						
Antimony	0.143	NC	6	—	—	—
Arsenic	20.0	NC	1	180.0	NC	3
Barium	—	—	—	1,600	NC	9
Beryllium	0.050	PC NC	2 23	6,317	PC NC	1 22
Cadmium	0.0473	NC	12	53.4	NC	4
Chromium	1.885	NC	5	26,500	NC	2
Copper	—	—	—	5,890	NA	NA
Lead	0.200	NA	NA	5,200	NA	NA
Mercury	—	—	—	8,639	NC	1
Nickel	0.176	NC	24	247.0	NC	13
Selenium	0.200	NC	17	—	—	—
Silver	1.00	NC	7	13.5	NC	19
Thallium	0.0047	NA	NA	—	—	—
Zinc	114.0	NC	4	2,840	NC	12
<u>Volatile Organic Chemicals</u>						
Benzene	0.098	PC	9	2,647	PC	1
Bromodichloromethane	0.0032	PC NC	13 46	—	—	—

TABLE 5. (CONT.)

Chemical	Groundwater			Soil		
	Maximum Concentration (mg/L)	Toxicologic Class ^a	Relative Risk Ranking	Maximum Concentration (mg/kg)	Toxicologic Class ^a	Relative Risk Ranking
<u>VOCs (Cont.)</u> Carbon tetrachloride	0.069	PC NC	7 10	—	—	—
Chloroform	0.028	PC NC	16 30	—	—	—
2-Chlorophenol	0.080	NC	20	—	—	—
1,4-Dichlorobenzene	0.123	PC	8	—	—	—
Dichloromethane	0.072	PC NC	12 34	—	—	—
<i>N</i> -Nitrosodiphenylamine	0.013	PC	17	—	—	—
Nitroso- <i>di-N</i> -propylamine	0.120	PC	1	3.3	PC	2
Pentachlorophenol	0.096	PC NC	5 27	—	—	—
Phenol	0.041	NC	50	—	—	—
Tetrachloroethylene	0.0059	NC	38	—	—	—
Trichloroethylene	0.010	NA	NA	0.005	NA	NA
<u>Anions</u> Fluoride	0.0878	NC	3	—	—	—
Nitrate	40.0	NC	19	—	—	—
Nitrite	18.0	NC	9	—	—	—
Sulfate	8,100	NA	NA	—	—	—
<u>Nitroaromatics</u> 1,3-Dinitrobenzene	0.0095	NC	11	2.515	NC	7

TABLE 5. (CONT.)

	Groundwater				Soil		
			PC	3	4.51	PC	3
<u>Nitroaromatics (Cont.)</u> 2,4-Dinitrotoluene	0.0883		PC	3	4.51	PC	3
2,6-Dinitrotoluene	0.0205		PC	4	4.44	PC	4
HMX	0.0126		NC	43	4.87	NC	32
Nitrobenzene	0.0375		NC	14	—	—	—
RDX	0.0158		PC NC	10 25	4.76	PC NC	9 20
Tetryl	0.019		NC	32	10.0	NC	25
1,3,5-Trinitrobenzene	0.0098		NC	8	2.29	NC	5
2,4,6-Trinitrotoluene	0.0296		PC NC	11 15	5.005	PC NC	10 15
<u>Polynuclear Aromatic Hydrocarbons</u> Naphthalene	3.72		NC	13	—	—	—
<u>Phthalates</u> Bis(2-ethylhexyl)phthalate	0.810		PC NC	6 16	—	—	—
<u>Pesticide</u> DDD	—		—	—	5.44	PC	5
<u>Total Petroleum Hydrocarbons</u>	—		—	—	12,800	NA	NA
<u>Agent Breakdown</u> Isopropylmethyl phosphonic acid	3.0		NA	NA	—	—	—
<u>Radionuclides</u> Gross alpha (pCi/L)	4,720		NA	NA	—	—	—
Gross beta (pCi/L)	504		NA	NA	—	—	—
Uranium (pCi/L)	121		NA	NA	—	—	—

*PC = potential carcinogen; NC = noncarcinogen; NA = not available

TABLE 6. CHEMICALS WITH MCLS THAT WERE NOT SELECTED
AS CHEMICALS OF POTENTIAL CONCERN FOR TEAD-S

Chemical	MCL ($\mu\text{g/L}$) ^a	Maximum Concentration ($\mu\text{g/L}$)
Copper	1,300 ^b	124
Cyanide	200	10
1,2-Dichlorobenzene	600	78
1,1-Dichloroethylene	7	0.4
1,2-Dichloroethylene	(<i>cis</i> -) 70 (<i>trans</i> -) 100	2.9
1,2-Dichloropropane	5	0.4
Ethylbenzene	700	87.8
Mercury	2	0.9
Toluene	1,000	19.4
1,1,1-Trichloroethane	200	1.6
1,1,2-Trichloroethane	5	0.2
Xylene (total)	10,000	2,000

^a Federal Safe Drinking Water Act (SDWA) maximum contaminant level (MCL).

^b Properly termed an "action level," not an MCL, under the federal SDWA (56 FR 26460, June 7, 1991; effective December 7, 1992), exceedence of this level triggers initiation of corrosion control studies and treatment requirements.

TABLE 7. RANGE OF CONCENTRATIONS, FREQUENCY OF DETECTION, CERTIFIED REPORTING LIMIT, AND BACKGROUND LEVELS FOR GROUNDWATER CHEMICALS OF CONCERN AT TEAD-S*

Chemical	Range of Detected Concentrations ^b	Frequency of Detection	Certified Reporting Limit ^c	Background Levels ^d
Antimony	3.86-143.0	25.3	3.0	<38-140
Arsenic	3.09-20,000	78.8	5.0	<2.54-1,300
Benzene	0.295-98.0	14.2	0.67	NA
Beryllium	0.20-50.0	5.6	0.10	<5.0
Bis(2-ethylhexyl)phthalate	2.0-810.0	5.7	10 (TRL)	NA
Bromodichloromethane	3.2	0.8	5 (TRL)	NA
Cadmium	4.58-47.26	8.0	5.10	<4.0
Carbon tetrachloride	17.0-69.0	1.6	5 (TRL)	NA
Chloroform	0.84-28.2	22.0	5 (TRL)	NA
2-Chlorophenol	79.0-80.0	2.2	10 (TRL)	NA
Chromium	5.0-1,884	33.3	37.5	<6.0-31
1,4-Dichlorobenzene	0.346-123.4	2.5	10 (TRL)	NA
Dichloromethane	6.18-71.6	12.1	5 (TRL)	NA
1,3-Dinitrobenzene	0.99-9.5	2.9	0.61	NA
2,4-Dinitrotoluene	0.88-88.27	2.8	0.60	NA
2,6-Dinitrotoluene	16.3-20.5	1.0	0.55	NA
Fluoride	135.0-100,000	33.1	50 (TRL)	<71-55,000
Gross alpha	3.7-4,720 (pCi/L)	93.3	NA	NA
Gross beta	0.5-504 (pCi/L)	49.3	NA	NA
HMX	11.6-12.6	1.5	1.3	NA
Isopropylmethyl phosphonic acid	1.2-3,000	20.7	NA	NA
Lead	1.41-200.0	61.4	2.5	<1.3-46
Naphthalene	31.4-3,720	12.7	10 (TRL)	NA
Nickel	5.0-176.24	23.8	9.6	<34
Nitrate	30.8-40,000	68.1	500 (TRL)	NA
Nitrite	2.7-18,000	45.2	500 (TRL)	NA

TABLE 7. (CONT.)				
Chemical	Range of Detected Concentrations ^b	Frequency of Detection Limit	Certified Reporting Limit ^c	Background Levels ^d
<i>N</i> -Nitrosodiphenylamine	2.56-37.5	1.0	1.13	NA
<i>N</i> -Nitrosodiphenylamine	13.0	0.7	10 (TRL)	NA
Nitroso- <i>di-N</i> -propylamine	115.7-119.8	1.9	10 (TRL)	NA
Pentachlorophenol	58.0-96.0	2.0	50 (TRL)	NA
Phenol	3.0-41.0	2.2	10 (TRL)	NA
Selenium	3.3-200.0	27.6	5.0	<3.0-200
Silver	0.18-1,000	23.8	0.19	<4.6
Sulfate	1.89-8,100,000	93.5	125,000 (TRL)	NA
RDX	1.9-15.8	3.3	0.63	NA
Tetrachloroethylene	0.03-5.86	1.5	5 (TRL)	NA
Tetryl	1.25-19.0	4.5	0.66	NA
Thallium	2.4-4.7	3.1	5.0	NA
Trichloroethylene	0.76-10.0	8.1	0.71	NA
1,3,5-Trinitrobenzene	0.46-9.8	5.1	0.56	NA
2,4,6-Trinitrotoluene	0.89-29.6	11.3	0.78	NA
Uranium	1.17-121.0 (pCi/L)	100.0	NA	NA
Zinc	1.0-114,000	59.1	17.2	<21-270

^aAll values are given in µg/L.

^bIRDMS, data printout March 1992.

^cAs reported in Weston 1990 (TRL = Target Reporting Limit).

^dAs reported in Ebasco 1992.

NA = not available

known human carcinogens by either the oral or inhalation routes, and chromium VI is classified as Group A via inhalation. However, chromium was selected based on its systemic toxicity, not carcinogenicity. Selection was based on site-related occurrence; maximum concentrations in exceedance of MCLs, proposed MCLs, or other health-based guidance values (see Table 10 for MCLs and TBC values); or potential toxicity based on relative risk ranking in CASIC.

Nitroso-di-*N*-propylamine, beryllium, 2,4-dinitrotoluene, and 2,6-dinitrotoluene presented approximately 96% of the carcinogenic risk to human health from groundwater contamination at the site. Approximately 98% of the noncarcinogenic risk to human health, as calculated in CASIC, can be attributed to arsenic, uranium, fluoride, and zinc.

Soil. The primary contaminants selected for soils at TEAD-S were metals, nitroaromatics, DDD, and total petroleum hydrocarbons. Table 8 presents information concerning the range of detected concentrations, frequency of detection, certified reporting limits, and background values for soil COCs at TEAD-S. Selection of soil COCs was based on exceedance of site background levels, exceedance of RCRA action levels or concentration-based exemption levels, site-related occurrence, or potential toxicity based on relative risk ranking in CASIC. Beryllium, nitroso-di-*N*-propylamine, 2,4-dinitrotoluene, 2,6-dinitrotoluene, and DDD presented approximately 95% of the carcinogenic risk from soil contamination at the site; whereas, mercury and chromium presented 97% of the noncarcinogenic risk. All of the metals selected, with the exception of barium, exceeded site background levels. Total petroleum hydrocarbons were selected based on site-related occurrence, detected at maximum concentrations as high as 12,800 mg/kg in soils (sample site 14-04) at SWMU 14, the Former Motor Pool.

2.1.2. Federal and State ARARs

2.1.2.1. Groundwater and Drinking Water

In the final National Contingency Plan (NCP), EPA states the preference for Safe Drinking Water Act (SDWA) MCLs and non-zero maximum contaminant level goals (MCLGs) or other health-based standards, criteria, or guidance for cleanup of Class I and II groundwater at CERCLA sites (55 FR 8732). The goal of EPA's approach to cleanup contaminated groundwater is to return usable groundwater to its beneficial use within a given time frame that is reasonable given the particular circumstances at a CERCLA site. Although not an ARAR unless promulgated, the EPA guidance on groundwater classification should be used to help in determining whether groundwater at a site falls within Class I, II, or III. Groundwater at both the North and South areas of TEAD are used as potable water supplies either on the installations or in adjacent towns (see Section 1) (Weston 1990; Ebasco 1992); consequently, groundwater at TEAD-N and TEAD-S would be considered either Class I or IIA, representing a current source of drinking water of varying value. Restoration time periods vary depending on the use classification of the groundwater and may range from one year to several decades.

Although limited in number, chemical-specific standards pertaining to water quality have been established under the SDWA in 40 CFR 141 as National Primary Drinking Water Standards (NPDWS). These regulations are applicable to public water systems that have at least 15 service connections or serve an average of at least 25 people daily at least 60 days of the year. NPDWS include MCLs and MCLGs. The MCLs are enforceable standards that take into consideration human health effects, available treatment technologies, and costs of treatment. MCLGs are

TABLE 8. RANGE OF CONCENTRATIONS, FREQUENCY OF DETECTION, CERTIFIED REPORTING LIMIT, AND BACKGROUND LEVELS FOR SOIL CHEMICALS OF CONCERN AT TEAD-S*

Chemical	Range of Detected Concentrations ^b	Frequency of Detection	Certified Reporting Limit ^c	Background Levels ^d
Arsenic	6.43-180.0	35.4	5.7	12-39
Barium	110-1,600	100.0	NA	NA
Benzene	0.006-2.647	8.1	0.6 (TRL)	NA
Beryllium	0.136-6.317	45.2	0.33	0.23-0.38
Cadmium	1.07-53.4	16.8	0.7	<1.2-21
Chromium	1.37-26,500	56.5	2.5	17-56
Copper	3.57-5,890	59.7	3.82	11-58
DDD	5.44	0.5	1.0 (TRL)	NA
1,3-Dinitrobenzene	2.36-2.515	2.3	0.59	NA
2,4-Dinitrotoluene	2.7-4.51	2.2	0.42	NA
2,6-Dinitrotoluene	4.22-4.44	1.0	0.40	NA
HMX	4.63-4.87	2.3	1.27	NA
Lead	4.94-5,200	39.7	4.78	9.4-250
Mercury	0.029-8,638.7	33.0	0.1	<0.03-0.32
Nickel	7.0-247.0	19.5	4.8	<2.7
Nitro- <i>o</i> -N-propylamine	2.84-3.3	2.7	0.3 (TRL)	NA
RDX	4.37-4.76	2.0	0.98	NA
Silver	0.063-13.5	19.4	0.65	0.09-1.8
Tetryl	3.796-10.0	2.1	0.25	NA
Total Petroleum Hydrocarbon	2.0-12,800	23.7	NA	NA
Trichloroethylene	0.005	0.9	0.14	NA
1,3,5-Trinitrobenzene	2.096-2.29	2.3	2.09	NA
2,4,6-Trinitrotoluene	4.63-5.0	2.0	1.92	NA
Zinc	2.0-2,840	45.6	52.0	46-230

*All values are given in mg/kg (ppm).

^bIRDS, data printout March 1992.

^cAs reported in Weston 1990 (TRL = Target Reporting Limit).

^dAs reported in Ebasco 1992.

NA = not available

strictly health-based standards that disregard cost or treatment feasibility and are not legally enforceable. MCLs are legally applicable to water "at the tap" but are not legally applicable to cleanup of groundwater or surface water. However, they may be considered as relevant and appropriate at TEAD-N and TEAD-S where groundwater is, or may be, used for drinking. The chemical-specific ARARs for cleanup of groundwater at both TEAD-N and TEAD-S will be discussed in this section and are presented in Tables 9 and 10, respectively.

Pursuant to the SDWA amendments of 1986, EPA has promulgated MCLs for fluoride (51 FR 11396, April 2, 1986); benzene, carbon tetrachloride, 1,4-dichlorobenzene, and trichloroethylene (52 FR 25690, July 8, 1987); cadmium, chromium, nitrate, nitrite, selenium, and tetrachloroethylene (56 FR 3526, January 30, 1991; effective July 30, 1992); pentachlorophenol (56 FR 30266, July 1, 1991; effective January 1, 1993); and antimony, benzo[a]pyrene, beryllium, bis(2-ethylhexyl)phthalate, dichloromethane, nickel, thallium, (see Tables 9 and 10). A National Interim Primary Drinking Water Regulation (NIPDWR) has been established for arsenic (40 FR 59570, December 24, 1975) (see Tables 9 and 10). NIPDWR were established for gross alpha and gross beta radioactivity (41 FR 28404, July 9, 1976). These interim values were changed to proposed status in July 1991 (56 FR 33050, July 18, 1991) with a final rule expected in April 1993. These values will be considered relevant and appropriate for cleanup of these chemicals in groundwater.

The State of Utah, under UAC R309-103, as revised July 1, 1991, has promulgated "Water Quality MCLs" for public water systems. The majority of Utah's primary drinking water standards under UAC R309-103-1 for the COCs at TEAD-N and TEAD-S are the same as or no more stringent than the federal SDWA MCLs; however, the state standards for two chemicals of concern, chromium and selenium, are stricter (see Tables 9 and 10). The state is requesting an extension from EPA to amend its regulations for these EPA Phase II contaminants by relaxing the standards in order to align itself with the federal rules (Bousfield 1992). Utah has a primary MCL for lead of 50 µg/L; however, the Utah Department of Environmental Quality plans to propose a maximum contaminant "action" level for lead in the fall of 1992 that will be consistent with the federal action level (see Section 2.2.1.), which becomes effective on December 7, 1992 (Blake 1992). In addition, Utah has promulgated primary drinking water standards for silver and sulfate, which only have secondary MCLs in effect under the SDWA (see Tables 9 and 10). Under UAC R309-103-1.1.d, Utah has set an MCL of 500 to 1,000 mg/L for sulfate with certain qualifications. If the sulfate level of a public water system (community, noncommunity or nontransient, noncommunity) is above 500 mg/L, the water supplier "must satisfactorily demonstrate that: a) no better water quality is available and b) the water shall not be available for human consumption from commercial establishments". The state also plans on adopting the proposed federal SDWA MCL for sulfates when it is promulgated. In the interim; however, the Utah standards for chromium, selenium, silver, and sulfate would be relevant and appropriate for cleanup of contaminated groundwater at TEAD-N and TEAD-S.

Secondary MCLs (SMCLs) have also been established under the SDWA for chloride and zinc (44 FR 42198, July 19, 1979); however, National Secondary Drinking Water Standards regulate the aesthetic qualities related to public acceptance of drinking water. These standards are not federally enforceable, but rather are intended to serve as guidelines for use by states in regulating water supplies. Utah has promulgated SMCLs for these chemicals in UAC R309-103, revised July 1, 1991 that are identical to the federal values (see Tables 9 and 10). These state secondary standards are intended as recommended levels.

TABLE 9. CHEMICAL-SPECIFIC APPLICABLE OR RELEVANT AND APPROPRIATE REQUIREMENTS (ARARS) FOR CLEANUP OF GROUNDWATER AT TEAD-N (µg/L)^a

Chemical	SDWA ^b MCL/MCLG ^c	Proposed SDWA MCL/MGCL	Utah MCLs ^d	TBC Value ^e
<u>Metals</u>				
Arsenic	<u>50^f</u>	-	50	-
Chromium	100/100 ^g	-	<u>50</u>	-
Lead	-	-	<u>50</u>	15/0 ^h
Nickel	<u>100/100ⁱ</u>	-	-	-
Thallium	<u>2/0.5^j</u>	-	-	-
Zinc	5,000 ^j	-	5,000 ^j	<u>2,100^k</u>
<u>Organics</u>				
Benzene	<u>5/0^l</u>	-	5	-
Bis(2-ethylhexyl)- phthalate	<u>6/0^l</u>	-	-	-
Trichloroethylene	<u>5/0^l</u>	-	5	-
<u>Anions</u>				
Chloride	250,000 ^j	-	250,000 ^j	-
Nitrite/Nitrate	<u>10,000/ 10,000^g</u>	-	-	-
Sulfate	250,000 ^j	400,000/ 500,000 ^m	<u>500,000- 1,000,000</u>	-
<u>Nitroaromatics</u>				
2,4-Dinitrotoluene	-	-	-	<u>0.05ⁿ</u>
HMX	-	-	-	<u>400^k</u>
RDX	-	-	-	<u>2^k</u>
1,3,5-Trinitrobenzene	-	-	-	<u>2^o</u>
2,4,6-Trinitrotoluene	-	-	-	<u>2^k</u>

TABLE 9 (Cont.)

*The underlined values indicate the ARAR or TBC for each chemical.

^bSDWA = Safe Drinking Water Act.

^cMCL = Maximum Contaminant Level; MCLG = Maximum Contaminant Level Goal.

^dUtah Administrative Code R309-103, effective July 1, 1991.

^eTBC = to be considered guidance.

^f40 FR 59570 (December 24, 1975).

^g56 FR 3526 (January 30, 1991); effective July 30, 1992.

^hEstablished as an action level/MCLG, 56 FR 26460 (June 7, 1991) effective December 7, 1992.

ⁱ57 FR 31776 (July 17, 1992), effective January 17, 1994.

^jNational secondary drinking water standard; designed to protect the aesthetic quality of water (44 FR 42198, July 19, 1979), also Utah Secondary Maximum Contaminant Levels.

^kUSEPA Office of Drinking Water lifetime health advisory.

^l52 FR 25690 (July 8, 1987).

^m55 FR 30370 (July 25, 1990).

ⁿEstimated from a carcinogen slope factor for a risk of 10^{-6} . The concentration in drinking water that will result in one excess cancer death in 1×10^6 people following a lifetime exposure to contaminated drinking water.

^oEstimated from a reference dose. The concentration in drinking water that is assumed to result in no adverse health effects following daily ingestion for a lifetime.

TABLE 10. CHEMICAL-SPECIFIC APPLICABLE OR RELEVANT AND APPROPRIATE REQUIREMENTS (ARARS) FOR CLEANUP OF GROUNDWATER AT TEAD-S (µg/L)^a

Chemical	SDWA ^b MCL/MCLG ^c	Proposed SDWA MCL/MGCL	Utah MCLs ^d	TBC Value ^e
<u>Metals</u>				
Antimony	<u>6/6^f</u>	—	—	—
Arsenic	<u>50^g</u>	—	50	—
Beryllium	<u>4/4^f</u>	—	—	—
Cadmium	<u>5/5^h</u>	—	10	—
Chromium	100/100 ^b	—	<u>50</u>	—
Lead	—	—	<u>50</u>	15/0 ⁱ
Nickel	<u>100/100^f</u>	—	—	—
Selenium	50/50 ^h	—	<u>10</u>	—
Silver	100 ^j	—	<u>50</u>	—
Thallium	<u>2/0.5^f</u>	—	—	—
Zinc	5,000 ^j	—	5,000 ^j	<u>2,100^k</u>
<u>Volatile Organic Compounds</u>				
Benzene	<u>5/0^l</u>	—	5	—
Bromodichloromethane	—	—	—	<u>0.27^m</u>
Carbon tetrachloride	<u>5/0^l</u>	—	5	—
Chloroform	—	—	—	<u>5.7^m</u>
2-Chlorophenol	—	—	—	<u>40^k</u>
1,4-Dichlorobenzene	<u>75/75^l</u>	—	75	—
Dichloromethane	<u>5/0^l</u>	—	—	—
N-Nitrosodiphenylamine	—	—	—	<u>7.1^m</u>
Nitroso-di-N-propyl- amine	—	—	—	<u>0.005^m</u>
Pentachlorophenol	<u>1/0ⁿ</u>	—	—	—
Phenol	—	—	—	<u>4,000^k</u>
Tetrachloroethylene	<u>5/0^h</u>	—	—	—
Trichloroethylene	<u>5/0^l</u>	—	5	—

Table 10. (Cont.)

Chemical	SDWA ^b MCL/MCLG ^c	Proposed SDWA MCL/MGCL	Utah MCLs ^d	TBC Value ^e
<u>Anions</u>				
Fluoride	<u>4,000/</u> <u>4,000^a</u>	—	4,000	—
Nitrite	<u>1,000/</u> <u>1,000^a</u>	—	—	—
Nitrate	<u>10,000/</u> <u>10,000^a</u>	—	10,000	—
Sulfate	250,000 ^f	400,000/ 500,000 ^g	<u>500,000—</u> <u>1,000,000</u>	—
<u>Nitroaromatics</u>				
1,3-Dinitrobenzene	—	—	—	<u>1.0^k</u>
2,4-Dinitrotoluene	—	—	—	<u>0.05^m</u>
2,6-Dinitrotoluene	—	—	—	<u>0.05^m</u>
HMX	—	—	—	<u>400^k</u>
Nitrobenzene	—	—	—	<u>17.5^q</u>
RDX	—	—	—	<u>2^k</u>
Tetryl	—	—	—	<u>350^q</u>
1,3,5-Trinitrobenzene	—	—	—	<u>2^q</u>
2,4,6-Trinitrotoluene	—	—	—	<u>2^k</u>
<u>Polynuclear Aromatic Hydrocarbons</u>				
Naphthalene	—	—	—	<u>20^k</u>
<u>Phthalates</u>				
Bis(2-ethylhexyl)- phthalate	<u>60^f</u>	—	—	—
<u>Agent Breakdown</u>				
Isopropylmethyl phosphonic acid	—	—	—	<u>700^k</u>
<u>Radionuclides</u>				
Gross alpha	<u>15 pCi/L^r</u>	15 pCi/L ^r	15 pCi/L	—

Table 10. (Cont.)				
Chemical	SDWA ^b MCL/MCLG ^c	Proposed SDWA MCL/MGCL	Utah MCLs ^d	TBC Value ^e
Gross beta	<u>4 mrem</u> <u>/yr^f</u>	4 mrem/yr ^f	4 mrem/yr	-
Uranium	-	20 ^g	-	-

*The underlined values indicate the ARAR or TBC for each chemical.

^bSDWA = Safe Drinking Water Act.

^cMCL = Maximum Contaminant Level; MCLG = Maximum Contaminant Level Goal.

^dUtah Administrative Code R309-103, effective July 1, 1991.

^eTBC = to be considered guidance.

^f57 FR 31776 (July 17, 1992), effective January 17, 1992.

^g40 FR 59570 (December 24, 1975).

^h56 FR 3526 (January 30, 1991); effective July 30, 1992.

ⁱEstablished as an action level/MCLG, 56 FR 26460 (June 7, 1991) effective December 7, 1992.

^jNational secondary drinking water standard; designed to protect the aesthetic quality of water (44 FR 42198, July 19, 1979), also Utah Secondary Maximum Contaminant Levels.

^kUSEPA Office of Drinking Water lifetime health advisory.

^l52 FR 25690 (July 8, 1987).

^mEstimated from a carcinogen slope factor for a risk of 10⁻⁶. The concentration in drinking water that will result in one excess cancer death in 1 x 10⁶ people following a lifetime exposure to contaminated drinking water.

ⁿ56 FR 30266 (July 1, 1991), effective January 1, 1993.

^oMCL - 51 FR 11396 (April 2, 1986); applies to community water systems; MCLG - 50 FR 47141 (November 14, 1985).

^p55 FR 30370 (July 25, 1990).

^qEstimated from a reference dose. The concentration in drinking water that is assumed to result in no adverse health effects following daily ingestion for a lifetime.

^r41 FR 28404 (July 9, 1976). These interim values were changed to proposed status in July 1991 (56 FR 33050, July 18, 1991); final rule expected April 1993.

Pursuant to the SDWA amendments of 1986, EPA has proposed MCLs and MCLGs for sulfate (55 FR 30370, July 25, 1990) and for uranium (56 FR 33050, July 18, 1991; final rule expected April 1993) (see Tables 9 and 10). The proposed federal MCL for sulfates is more stringent than the current state MCL. The EPA Regulatory Agenda states that an MCL for arsenic will be proposed in November 1992 (56 FR 18014, April 22, 1991). When the proposed MCLs are promulgated, they will be considered relevant and appropriate for cleanup of these chemicals in groundwater at TEAD-N and TEAD-S.

Utah has promulgated classifications for groundwater sources within the state based on ambient aquifer water quality (UAC R448-6-4, effective 1989). These regulations are applicable to "[a]ny person who [...] operates a facility that discharges or would probably discharge to ground water" (UAC R448-6-4.1.C). Currently groundwater sources at TEAD-N and TEAD-S have yet to be classified by the state. Thus, the state will make a site-specific classification from information provided by the Army on concentrations of total dissolved solids and contaminants (Barnes 1991). When such a classification is made for the groundwater at TEAD, the protection levels set in UAC R448-6-4 would be applicable for cleanup of contaminated groundwater at TEAD-N and TEAD-S. Based solely on data provided in Figure 3-2 of the Tooele Army Depot Preliminary Assessment/Site Investigation Final Report, it appears that the groundwater underlying TEAD-S will be designated Class II (Barnes 1991; EESTI 1988). Class II groundwater is to be protected for use as drinking water or other similar beneficial uses following conventional treatment prior to use (UAC R448-6-4.5.A). State regulations set Class II protection levels for total dissolved solids and for contaminants based on background concentrations. The following protection levels apply to Class II groundwater:

- "1. Total dissolved solids may not increase above 1.25 times the background value.
2. When a contaminant is not present in a detectable amount as a background concentration, the concentration of the pollutant may not exceed 0.25 times the groundwater quality standard, or exceed the limit of detection, whichever is greater.
3. When a contaminant is present in a detectable amount as a background concentration, the concentration of the pollutant may not exceed 1.25 times the background concentration or exceed 0.25 times the groundwater quality standard, whichever is greater.
4. In no case will the concentration of a pollutant be allowed to exceed the groundwater quality standard."

These state Groundwater Standards listed in Table 1 of UAC R448-6-2 (effective 1989) and the proposed standards (UAC R448-6-2, August 23, 1991; effective late 1992) are identical to the federal or state MCLs. However, upon classification of TEAD groundwater, they would be applicable for cleanup of groundwater at TEAD; whereas, the MCLs would be relevant and appropriate.

2.1.2.2. Soil

There are no set maximum allowable residual levels for chemicals in soils under federal or state law. Each contaminated site is judged on an individual basis by the state with reference to background levels for the COCs (provided as available in Section 2.2.2.) as well as other criteria as determined by the state in order to set soil cleanup levels (Thiriot 1991).

RCRA has addressed land disposal of treated hazardous wastes in its land disposal restrictions (40 CFR 268). For each hazardous waste, EPA has established treatment standards that are protective of human health and the environment when the wastes are land disposed. Land disposal includes placement in a landfill, surface impoundment, waste pile, or land treatment facility. Wastes may be land disposed if they have been treated with the best demonstrated available technology (BDAT) set by EPA and meet the treatment standards. However, EPA has determined that the RCRA treatment standards are generally inappropriate or infeasible when applied to contaminated soil or debris (55 FR 8760). Therefore, EPA is proposing separate rulemakings to establish treatment standards for disposal of such contaminated soil and debris. The Advanced Notice of Proposed Rulemaking (ANPRM) for debris appeared in 56 FR 24444, May 30, 1991; the Notice of Proposed Rulemaking (NPRM) appeared January 9, 1992 (57 FR 958); with a final rule published on August 18, 1992 (57 FR 37194, effective November 16, 1992). The ANPRM for soil appeared in 56 FR 55160, October 24, 1991; the NPRM is expected in September 1992; with a final rulemaking in May 1993. These will be analyzed as ARARs or TBC when available. In the interim, EPA has developed guidance for obtaining and complying with a treatability variance for soil and debris that are contaminated with RCRA hazardous wastes for which treatment standards have already been set (OSWER Directive 9347.3-06FS, July 1989). Alternate treatment levels are presented for structural functional groups of organics and for ten inorganics based on actual treatment of soil and best management practices for debris. These will be considered as TBC guidance when remedial alternatives are selected and more information becomes available on waste types.

In the final NCP, EPA reaffirms that movement of waste within a unit does not constitute "land disposal" for purposes of application of the RCRA land disposal restrictions; however, waste consolidation from different units at a CERCLA site is subject to the restrictions (55 FR 8759). Determination of the applicability of the LDRs will depend on the selection of remedial alternatives at TEAD-N and TEAD-S.

2.2. OTHER GUIDANCE TO BE CONSIDERED

2.2.1. Groundwater

Lead. The EPA has set an action level of 15 µg/L for lead (in no more than 10% of tap water samples) that would provide TBC guidance for cleanup of groundwater at TEAD-N and TEAD-S. Exceedance of the action level indicates potential source water (groundwater) contamination and triggers the need to implement either optimal corrosion control for systems serving <50,000 people or source water monitoring and possible treatment, public education, and lead service line replacement for all systems. It is not equivalent to an MCL but is a treatment technique requirement. Upon exceedance, the water system is required to collect source water samples and submit the results to the state of Utah. Within six months of exceeding the lead action level, the water system is required to recommend in writing to the state a proposed source water treatment. The state of Utah would then be required to analyze the monitoring results and treatment recommendation to determine the technology that would be most effective at reducing contaminant levels in water delivered to the user's tap. Follow-up source water and tap samples are to be taken within 12 months of the installation of the treatment and submitted to the state. The state will then establish maximum permissible lead levels in source water that the water system must maintain. It is assumed that remediation to these maximum permissible lead levels would be required.

In the absence of federal- or state-promulgated ARARs, or in the case where ARARs are not adequately protective, EPA states a preference for Office of Drinking Water (ODW) Health Advisories (HAs) and RfDs for systemic toxicants and SFs for carcinogens (USEPA 1988; 53 FR 51394, December 21, 1988). RfDs and SFs are available from the EPA IRIS database (USEPA 1992a) and/or the EPA Health Effects Assessment Summary Tables (HEAST) (USEPA 1992b).

2-Chlorophenol; 1,3-Dinitrobenzene; HMX; Isopropylmethyl phosphonic acid; Naphthalene; Phenol; RDX; 2,4,6-Trinitrotoluene; Zinc. EPA has set lifetime drinking water HAs of 40; 1; 400; 700; 20; 4,000; 2; 2; and 2,100 for 2-chlorophenol, 1,3-dinitrobenzene; HMX; Isopropylmethyl phosphonic acid; naphthalene; phenol; RDX; 2,4,6-trinitrotoluene; and zinc, respectively (see Tables 9 and 10) (USEPA 1992c). These values are calculated assuming that an individual receives 80% of his exposure from sources other than consumption of drinking water. If a risk assessment at TEAD-N or TEAD-S indicates that 100% of a person's exposure to these chemicals would come from drinking water sources, corrected values would be 5 times these given values.

Estimates of acceptable concentrations in drinking water for the remaining chemicals of concern (see Tables 9 and 10) were derived using RfDs and SFs from IRIS (USEPA 1992a) or HEAST (USEPA 1992b) as follows:

Bromodichloromethane. EPA has classified this chemical as a Group B2 carcinogen. Using the equation given below and an oral carcinogen potency factor of $0.13 \text{ (mg/kg/day)}^{-1}$ (USEPA 1992a), a concentration of $0.27 \text{ }\mu\text{g/L}$ in groundwater may be calculated that would result in one excess cancer in 10^6 individuals.

$$C_w = \frac{(70) \times (1 \times 10^{-6})}{q_1^* \times 2}$$

where

C_w	=	Concentration in water only, calculated to keep the lifetime risk below 10^{-6} following ingestion of drinking water alone;
70	=	Assumed body weight of an adult, kg;
1×10^{-6}	=	Selected risk level;
q_1^*	=	Carcinogenic slope factor for humans $(\text{mg/kg/day})^{-1}$; and
2	=	Assumed daily water ingestion rate of an adult, L/day.

Chloroform. EPA has classified this chemical as a Group B2 carcinogen. Using the above equation and an oral carcinogen potency factor of $0.0061 \text{ (mg/kg/day)}^{-1}$ (USEPA 1992a), a concentration of $5.7 \text{ }\mu\text{g/L}$ in groundwater may be calculated that would result in one excess cancer in 10^6 individuals.

2,4- and 2,6-Dinitrotoluene. EPA has recently issued a SF for both dinitrotoluene isomers, based on a study using technical grade DNT. EPA has classified both isomers as Group B2 carcinogens. Using the above equation and the SF of $0.68 \text{ (mg/kg/day)}^{-1}$ (USEPA 1992b), a

concentration in groundwater of 0.05 µg/L may be calculated that would result in one excess cancer in 10⁶ individuals consuming 2 L of water per day.

N-Nitrosodiphenylamine. EPA has classified this chemical as a Group B2 carcinogen. Using the above equation and an oral carcinogen potency factor of 0.0049 (mg/kg/day)⁻¹ (USEPA 1992a), a concentration of 7.1 µg/L in groundwater may be calculated that would result in one excess cancer in 10⁶ individuals.

Nitroso-di-N-propylamine. EPA has classified this chemical as a Group B2 carcinogen. Using the above equation and an oral carcinogen potency factor of 7.0 (mg/kg/day)⁻¹ (USEPA 1992a), a concentration of 0.005 µg/L in groundwater may be calculated that would result in one excess cancer in 10⁶ individuals.

Nitrobenzene. The guidance value is derived using the equation given below from an oral reference dose of 5.0E-04 mg/kg/day (USEPA 1992a). An acceptable concentration (C_w) in drinking water of 17.5 µg/L is calculated. The RfD for nitrobenzene is still available on IRIS, but is currently under review by the RfD workgroup (USEPA 1992a).

$$C_w = \frac{RfD \times 70}{2}$$

where

C _w	=	Concentration in water that will result in no adverse health effects following ingestion of contaminated drinking water alone, in µg/L;
RfD	=	Reference dose, in mg/kg/day;
70	=	Assumed body weight of an adult, kg; and
2	=	Assumed daily water ingestion rate of an adult, L/day.

Tetryl (Trinitrophenylmethylnitramine). The guidance value is derived as above from an oral RfD of 0.01 mg/kg/day (USEPA 1992a). An acceptable concentration (C_w) in drinking water of 350 µg/L is calculated.

1,3,5-Trinitrobenzene. The guidance value is derived as above from an oral RfD of 0.05 µg/kg/day (USEPA 1992a). An acceptable concentration (C_w) in drinking water of 2 µg/L is calculated. The RfD is calculated using data obtained from studies with 1,3-dinitrobenzene.

2.2.2. Soil

Lead. EPA has recommended cleanup values for lead in soils based on studies of blood lead levels in exposed children. The EPA Office of Solid Waste and Emergency Response (OSWER) Directive 9355.02 suggests a cleanup level for soils of 500-1000 ppm lead. In addition, for assessing the risk from exposure to lead in the soils at TEAD-N and TEAD-S, EPA's Uptake/Biokinetic Model can be used, upon approval of the EPA Regional Project Manager (RPM). The model provides a multimedia exposure approach to estimate the percentage (may vary from region to region) of the exposed population (children, ages 0-6) with blood lead levels above a critical value of 10 µg/dL.

Polynuclear aromatic hydrocarbons (PAHs). As an interim guidance, EPA Region IV has adopted a toxicity equivalency factor (TEF) approach for carcinogenic PAHs based on each compounds' relative potency to the potency of benzo[a]pyrene. Upon approval of the RPM for TEAD-N, the following TEFs could be used to convert the concentration of each PAH to an equivalent concentration of benzo[a]pyrene: 0.01 for chrysene; 0.1 for benzo[a]anthracene and benzo[b]fluoranthene; and 1.0 for and benzo[a]pyrene (USEPA 1992d). The oral carcinogen SF for benzo[a]pyrene is given in Table 13.

Total petroleum hydrocarbons (TPHCs). Unfortunately, no ARARs or TBC values are available to determine cleanup levels for TPHCs in soils.

In the proposed RCRA Hazardous Waste Identification Rule (57 FR 21510, May 20, 1992; final rule expected April 1993), EPA has proposed two approaches for determining if listed waste and contaminated media are subject to the hazardous waste management requirements under subtitle C of RCRA. The first approach establishes concentration-based-exemption criteria (CBEC) for listed hazardous wastes, wastes mixtures, derivatives, and media (including soils and groundwater) that are contaminated with certain RCRA wastes. The second approach established "characteristic" levels for the listed wastes in leachates as is performed under the current Toxicity Characteristics rule for an expanded number of toxic constituents (ECHO - Expanded Characteristics Option). Both criteria are human health risk-based levels. The proposed rule states that (57 FR 21498) EPA believes that CBEC/ECHO can be used as preliminary remediation goals (ARARs) for RCRA-listed wastes at CERCLA sites. The proposed CBEC/ECHO values are provided as potential TBC guidance for cleanup of COCs in soils at TEAD-N (Table 11) and at TEAD-S (Table 12). Site background levels where available for the COCs at each site have also been provided in these tables for comparison and also as potential TBC. There is currently significant discontent among state regulators concerning these approaches. However, if and when these values are promulgated, they could be applicable for cleanup of RCRA-listed contaminants at these sites and possibly relevant and appropriate for other COCs in contaminated soils at the sites.

In lieu of using any of the criteria presented in this report, cleanup levels for the COCs in contaminated soils at TEAD-N and TEAD-S may be determined by the USATHAMA contractor performing the RI using a site-specific risk assessment approach and the appropriate RfDs or SFs given in Table 13 for TEAD-N and in Table 14 for TEAD-S. The methodology outlined in RAGS (USEPA 1989) or the Preliminary Pollutant Limit Value (PPLV) methodology of Rosenblatt and Small (1981) may be utilized to quantitate exposure pathways and risk to individuals from exposure via the pathways of concern at a particular site. EPA Region IV has also provided the following interim guidance to be used in determining the risks associated with dermal exposure to contaminated soils: a) dermal absorption factors of 1.0% for organics and 0.1% for inorganics; and b) soil to skin adherence factors ranging from 0.2 to 1.0 mg/cm² (these factors differ from RAGS, based on new data (USEPA 1992d). Again, approval of the RPM for TEAD-N and TEAD-S must be obtained for using these factors in the risk calculations.

2.3 ACTION-SPECIFIC ARARs

When remedial alternatives have been selected for TEAD-N and TEAD-S, action-specific ARARs will be analyzed and provided under separate cover.

**TABLE 11. POTENTIAL TBC GUIDANCE LEVELS FOR CLEANUP OF
CONTAMINATED SOILS AT TEAD-N**

Chemical	RCRA CBEC mg/kg ^a	RCRA ECHO mg/L ^b	Site Background µg/g ^c
<u>Metals</u>			
Beryllium	0.3	0.1	ND ^d
Chromium	400	10	30
Lead	500	1.5	15
Nickel	1,000	10	7
Zinc	1,000	700	40
<u>Nitroaromatics</u>			
2,4-Dinitrotoluene	0.2 (0.7)	0.05	NA ^e
2,6-Dinitrotoluene	0.2 (0.7)	0.05	NA
HMX	NA	NA	NA
RDX	NA	NA	NA
1,3,5-Trinitrobenzene	4	0.2	NA
2,4,6-Trinitrotoluene	NA	NA	NA
<u>PAHs (carcinogenic)</u>			
Benzo[a]anthracene	0.05	0.01	NA
Benzo[a]pyrene	0.2	0.02	NA
Benzo[b]fluoranthene	0.1	0.02	NA
Chrysene	10	0.02	NA

^aValues in this column are Tier 1 CBEC (concentration-based exemption criteria) for soils proposed in the RCRA hazardous waste identification rule (57 FR 21510, May 20, 1992; final rule expected April 1993). Values in parentheses in this column are Exemption Quantitation Criteria (EQC). When a CBEC is below the EQC, the exemption demonstration must achieve an actual detection limit that is at least as low as the specified EQC.

^bValues in this column are the maximum contaminant concentrations for the Toxicity Characteristics (ECHO -Expanded Characteristics Option) for leachates proposed in the RCRA hazardous waste identification rule (57 FR 21510, May 20, 1992; final rule expected April 1993).

^cConcentrations of inorganics in soils in Tooele County; from Boerngen, J.G. and Shacklette, H.T., 1981.

^dND = Not detectable

^eNA = Not available

**TABLE 12. POTENTIAL TBC GUIDANCE LEVELS FOR CLEANUP OF
CONTAMINATED SOILS AT TEAD-S**

Chemical	RCRA CBEC mg/kg ^a	RCRA ECHO mg/L ^b	Site Background µg/g ^c
<u>Metals</u>			
Arsenic	20	5	12-39
Barium	1,000	200	NA ^d
Beryllium	0.3	0.1	0.23-0.38
Cadmium	40	0.5	<1.2-21
Chromium	400	10	17-56
Copper	NA	NA	11-58
Lead	500	1.5	9.4-250
Mercury	20	0.2	<0.03-0.32
Nickel	1,000	10	<2.7
Silver	400	20	0.09-1.8
Zinc	1,000	700	46-230
<u>Nitroaromatics</u>			
1,3-Dinitrobenzene	8	0.4	NA
2,4-Dinitrotoluene	0.2 (0.7)	0.05	NA
2,6-Dinitrotoluene	0.2 (0.7)	0.05	NA
HMX	NA	NA	NA
RDX	NA	NA	NA
Tetryl	NA	NA	NA
1,3,5-Trinitrobenzene	4	0.2	NA
2,4,6-Trinitrotoluene	NA	NA	NA
<u>VOCs</u>			
Benzene	40	0.5	NA
Nitroso-di-N-propylamine	0.2 (0.7)	0.01	NA
Trichloroethylene	100	0.5	NA
<u>Total Petroleum Hydrocarbons</u>	NA	NA	NA

TABLE 12. Cont.

Chemical	RCRA CBEC mg/kg ^a	RCRA ECHO mg/L ^b	Site Background µg/g ^c
DDD	5	0.1	NA
<u>Pesticides</u>			
DDD	5	0.1	NA

^aValues in this column are Tier 1 CBEC (concentration-based exemption criteria) for soils proposed in the RCRA hazardous waste identification rule (57 FR 21510, May 20, 1992; final rule expected April 1993). Values in parentheses in this column are Exemption Quantitation Criteria (EQC). When a CBEC is below the EQC, the exemption demonstration must achieve an actual detection limit that is at least as low as the specified EQC.

^bValues in this column are the maximum contaminant concentrations for the Toxicity Characteristics (ECHO -Expanded Characteristics Option) for leachates proposed in the RCRA hazardous waste identification rule (57 FR 21510, May 20, 1992; final rule expected April 1993).

^cBackground metal concentrations in soil (Ebasco 1992).

^dNA = Not available

**TABLE 13. REFERENCE DOSES (RfD), REFERENCE CONCENTRATIONS,
AND CARCINOGEN SLOPE FACTORS (SF) FOR CHEMICALS
DETECTED IN SOILS AT TEAD-N**

Chemical	Oral RfD ^a (mg/kg/day)	Inhalation RfC ^b (mg/m ³)	Oral SF ^c (mg/kg/day) ⁻¹	Inhalation SF (mg/kg/day) ⁻¹	Weight-of- Evidence Class
<u>Metals</u>					
Beryllium	5.0E-03 ^{d,e}	—	4.3E+00 ^e	8.40E+00 ^f	B2
Chromium (VI)	5.0E-03 ^e	—	ND ^g	4.10E+01 ^f	A
Lead	—	—	—	—	—
Nickel	2.0E-02 ^e	—	ND	—	ND
Zinc	2.0E-01 ^f	—	—	—	D
<u>Nitroaromatics</u>					
2,4-Dinitrotoluene	—	—	6.8E-01 ^f	—	B2
2,6-Dinitrotoluene	—	—	6.8E-01 ^f	—	B2
HMX	5.0E-02 ^e	—	—	—	D
RDX	3.0E-03 ^e	—	1.1E-01 ^e	—	C
1,3,5-Trinitrobenzene	5.0E-05 ^e	—	—	—	—
2,4,6-Trinitrotoluene	5.0E-04 ^e	—	3.0E-02 ^e	—	C
<u>PAHs (carcinogenic)</u>					
Benzo[a]anthracene	—	—	ND	—	B2
Benzo[a]pyrene	—	—	5.79E+00 ^e	6.1E+00 ^f	B2
Benzo[b]fluoranthene	—	—	ND	—	B2
Chrysene	—	—	ND	—	B2

^a RfD = Chronic Reference Dose.

^b RfC = Chronic Reference Concentration.

^c SF = Carcinogen Slope Factor.

^d Read as 5.0 times 10⁻³.

^e From IRIS (USEPA 1992a).

^f From HEAST (USEPA 1992b).

^g ND = Not determined.

TABLE 14. REFERENCE DOSES (RFD), REFERENCE CONCENTRATIONS, AND CARCINOGEN SLOPE FACTORS (SF) FOR CHEMICALS DETECTED IN SOIL AT TEAD-S

Chemical	Oral RFD ^a (mg/kg/day)	Inhalation RfC ^b (mg/m ³)	Oral SF ^c (mg/kg/day) ⁻¹	Inhalation SF (mg/kg/day) ⁻¹	Weight-of- Evidence Class
<u>Metals</u>					
Arsenic	3.0E-04 ^{d,e}	—	—	5.0E+01 ^f	A
Barium	7.0E-02 ^e	5.0E-04 ^f	—	—	—
Beryllium	5.0E-03 ^e	—	4.3E+00 ^e	8.40E+00 ^e	B2
Cadmium	5.0E-04 ^e	—	ND ^g	6.10E+00 ^f	B1
Chromium (VI)	5.0E-03 ^e	—	ND	4.10E+01 ^e	A
Copper	—	—	—	—	—
Lead	—	—	—	—	—
Mercury	3.0E-04 ^f	3.0E-04 ^f	—	—	D
Nickel	2.0E-02 ^e	—	ND	—	ND
Silver	5.0E-03 ^e	—	—	—	D
Zinc	2.0E-01 ^f	—	—	—	D
<u>Nitroaromatics</u>					
1,3-Dinitrobenzene	1.0E-04 ^e	—	—	—	D
2,4-Dinitrotoluene	—	—	6.8E-01 ^f	—	B2
2,6-Dinitrotoluene	—	—	6.8E-01 ^f	—	B2
HMX	5.0E-02 ^e	—	—	—	D
RDX	3.0E-03 ^e	—	1.1E-01 ^e	—	C
Tetryl	1.0E-02 ^f	—	—	—	—
1,3,5-Trinitrobenzene	5.0E-05 ^e	—	—	—	—
2,4,6-Trinitrotoluene	5.0E-04 ^e	—	3.0E-02 ^e	—	C
<u>VOCs</u>					
Benzene	—	—	2.9E-02 ^e	2.9E-02 ^f	A
Nitroso-di-N-propylamine	—	—	7.0E+00 ^e	—	B2
Trichloroethylene	—	—	—	—	B2

TABLE 14. Cont.

Chemical	Oral RfD ^a (mg/kg/day)	Inhalation RfC ^b (mg/m ³)	Oral SF ^c (mg/kg/day) ⁻¹	Inhalation SF (mg/kg/day) ⁻¹	Weight-of- Evidence Class
<u>Total Petroleum Hydrocarbons</u>	—	—	—	—	—
<u>Pesticides</u>					
DDD	—	—	2.4E-01 ^e	—	B2

^a RfD = Chronic Reference Dose.

^b RfC = Chronic Reference Concentration.

^c SF = Carcinogen Slope Factor.

^d Read as 3.0 times 10⁻⁴.

^e From IRIS (USEPA 1992a).

^f From HEAST (USEPA 1992b).

^g ND = Not determined.

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APPENDIX A

Indicator Chemical Worksheets

NORTH AREA

WORKSHEET W-1a SCORING FOR INDICATOR CHEMICAL SELECTION: CONCENTRATIONS IN WATER

CHEMNAME	SITE: tdn	C/N/B	Ground Water (mg/l)			Surface Water (mg/l)		
			Low	High	Repres.	Low	High	Repres.
ANTIMONY (METALLIC)		N					0.0112	
ARSENIC, INORGANIC		B	0.0052	0.1100			0.0027	
BARIUM		N	0.0230	0.4880		0.0610	0.0610	
BENZALDEHYDE		N						
BENZENE		C	0.0008	0.0016				
BENZO(A)PYRENE		C		0.0000				
BENZYL ALCOHOL		N	0.0000	0.0080			0.0000	
BERYLLIUM		B	0.0002	0.0016			0.0005	
BIS(2-ETHYLHEXYL)PHTHALATE		B	0.0100	0.7900				
BUTYL BENZYL PHTHALATE		N						
CADMIUM		B					0.0060	
CHLOROFORM		B		0.0020				
CHROMIUM(III)		N	0.0050	0.0519		0.0050	0.0150	
CHROMIUM(VI)		B	0.0050	0.0519		0.0050	0.0150	
CYANIDE (CN-)		N				0.0100	0.0100	
DICHLOROETHYLENE, 1,2-T-		N		0.0112				
DINITROTOLUENE, 2,4-		C	0.0075	0.2000				
DINITROTOLUENE, 2,6-		C						
FLUORANTHENE		N						
FLUORIDE		N	1.0000	1.0000		1.0000	1.0000	
HEXAHYDRO-1,3,5-TRINITRO-1,3,5-TRIAZINE		B	0.0010	0.2750		1.0000	1.0000	
MANGANESE		N						
MERCURY, INORGANIC		N		0.0002				
NICKEL (METALLIC)		N	0.0050	0.2940		0.0050	0.0200	
NITRATE		N	1.0000	1.0000		1.0000	1.0000	
NITRITE		N	0.5200	3050.0000			1.1800	
OCTAHYDRO-1,3,5,7-TETRANITRO-1,3,5,7-TETRA		N	0.0122	0.0232				
OCTYL PHTHALATE, DI-N-		N						
PHENOL		N	0.0010	0.0030				
POLYCHLORINATED BIPHENYLS		C						
PYRENE		N						
SELENIUM		N	0.0062	0.0088				
SILVER		N	0.0002	0.0026			0.0002	
TETRACHLOROETHYLENE		N		0.0011				
THALLIUM (IN SOLUBLE SALTS)		*		0.0034				
TOLUENE		N	0.0020	0.0130				
TRICHLOROETHANE, 1,1,1-		N						
TRICHLOROETHYLENE		*	0.0011	0.0476				
TRINITROBENZENE, 1,3,5-		N		0.1000				
TRINITROPHENYLMETHYLNITRAMINE		N					0.0010	
TRINITROTOLUENE, 2,4,6-		B	0.0010	0.0374				
ZINC (METALLIC)		N	0.001	2.435		0.001	0.08	

WORKSHEET W-1b SCORING FOR INDICATOR CHEMICAL SELECTION: CONCENTRATIONS IN SOIL AND SEDIMENT

CHEMNAME	SITE: tdn	C/N/B	Soil (mg/kg)		Repres.	Sediment (mg/kg)		
			Low	High		Low	High	Repres.
ANTIMONY (METALLIC)		N						
ARSENIC, INORGANIC		B	6.4790	25.8410			10.0000	
BARIUM		N					50.0000	
BENZALDEHYDE		N	0.1400	2.3000				
BENZENE		C	0.0000	0.0000				
BENZO(A)PYRENE		C	0.4400	0.6600				
BENZYL ALCOHOL		N	0.0000	0.0000			0.0000	
BERYLLIUM		B	0.2970	3.0000			0.0700	
BIS(2-ETHYLHEXYL)PHTHALATE		B	0.0700	4.8590				
BUTYL BENZYL PHTHALATE		N		0.5000				
CADMIUM		B	0.8210	7.2920				
CHLOROFORM		B						
CHROMIUM(III)		N	3.6050	217.7080			5.5000	
CHROMIUM(VI)		B	3.6050	217.7080			5.5000	
CYANIDE (CN-)		N						
DICHLOROETHYLENE, 1,2-T-		N						
DINITROTOLUENE, 2,4-		C	0.5100	80.0000				
DINITROTOLUENE, 2,6-		C		300.0000				
FLUORANTHENE		N	0.0900	0.6100				
FLUORIDE		N	1.3000	1000.0000				
HEXAHYDRO-1,3,5-TRINITRO-1,3,5-TRIAZINE		B	1.6730	1000.0000				
MANGANESE		N		0.5570				
MERCURY, INORGANIC		N	5.0800	81.9240			5.1000	
NICKEL (METALLIC)		N	3000.0000	4000.0000				
NITRATE		N	8.8100	1080.2900				
NITRITE		N	1.2760	95.2000				
OCTAHYDRO-1,3,5,7-TETRANITRO-1,3,5,7-TETRAH		N	0.0400	0.1400				
OCTYL PHTHALATE, DI-N-		N						
PHENOL		N						
POLYCHLORINATED BIPHENYLS		C	0.0190	0.2170				
PYRENE		N	0.0800	5.4000				
SELENIUM		N		5.8150				
SILVER		N				0.0200	0.2000	
TETRACHLOROETHYLENE		N					0.0850	
THALLIUM (IN SOLUBLE SALTS)		*						
TOLUENE		N		0.6350				
TRICHLOROETHANE, 1,1,1-		N						
TRICHLOROETHYLENE		*						
TRINITROBENZENE, 1,3,5-		N	3.5080	90.0000				
TRINITROPHENYLMETHYLNITRAMINE		N						
TRINITROTOLUENE, 2,4,6-		B	2.2650	*****				
ZINC (METALLIC)		N	53.6	2072.002		16	16.2	

WORKSHEET W-2 SCORING FOR INDICATOR SELECTION: TOXICITY DATA

CHEMNAME	SITE: tdn	TOX CLASS	WSS	AIR
ANTIMONY (METALLIC)		NC	4.00E-04	NA
ARSENIC, INORGANIC		PC	NA	5.00E+01
		NC	3.00E-04	NA
BARIUM		NC	7.00E-02	5.00E-04
BENZALDEHYDE		NC	1.00E-01	NA
BENZENE		PC	2.90E-02	2.90E-02
BENZO(A)PYRENE		PC	5.79E+00	6.10E+00
BENZYL ALCOHOL		NC	3.00E-01	NA
BERYLLIUM		PC	4.30E+00	8.40E+00
		NC	5.00E-03	NA
BIS(2-ETHYLHEXYL)PHTHALATE		PC	1.40E-02	NA
		NC	2.00E-02	NA
BUTYL BENZYL PHTHALATE		NC	2.00E-01	NA
CADMIUM		PC	NA	6.10E+00
		NC	5.00E-04	NA
CHLOROFORM		PC	6.10E-03	8.10E-02
		NC	1.00E-02	NA
CHROMIUM(III)		NC	1.00E+00	NA
CHROMIUM(VI)		PC	NA	4.10E+01
		NC	5.00E-03	NA
CYANIDE (CN-)		NC	2.00E-02	NA
DICHLOROETHYLENE, 1,2-T-		NC	2.00E-02	NA
DINITROTOLUENE, 2,4-		PC	6.80E-01	NA
DINITROTOLUENE, 2,6-		PC	6.80E-01	NA
FLUORANTHENE		NC	4.00E-02	NA
FLUORIDE		NC	6.00E-02	NA
HEXAHYDRO-1,3,5-TRINITRO-1,3,5-TRIAPC			1.10E-01	NA
		NC	3.00E-03	NA
MANGANESE		NC	1.00E-01	4.00E-04
MERCURY, INORGANIC		NC	3.00E-04	3.00E-04
NICKEL (METALLIC)		NC	2.00E-02	NA
NITRATE		NC	1.60E+00	NA
NITRITE		NC	1.00E-01	NA
OCTAHYDRO-1,3,5,7-TETRANITRO-1,3,5,NC			5.00E-02	NA
OCTYL PHTHALATE, DI-N-		NC	2.00E-02	NA
PHENOL		NC	6.00E-01	NA
POLYCHLORINATED BIPHENYLS		PC	7.70E+00	NA
PYRENE		NC	3.00E-02	NA
SELENIUM		NC	5.00E-03	NA
SILVER		NC	5.00E-03	NA
TETRACHLOROETHYLENE		NC	1.00E-02	NA
THALLIUM (IN SOLUBLE SALTS)		*		
TOLUENE		NC	2.00E-01	4.00E-01
TRICHLOROETHANE, 1,1,1-		NC	9.00E-02	1.00E+00
TRICHLOROETHYLENE		*		
TRINITROBENZENE, 1,3,5-		NC	5.00E-05	NA
TRINITROPHENYLMETHYLNITRAMINE		NC	1.00E-02	NA
TRINITROTOLUENE, 2,4,6-		PC	3.00E-02	NA
		NC	5.00E-04	NA
ZINC (METALLIC)		NC	2.00E-01	NA

WORKSHEET W-3 RISK FACTORS & RELATIVE RISK BY MEDIA - PC GROUP
 *** INDICATES NO DATA. "NA" INDICATES NO TOXICITY VALUE.

CHEMNAME	SITE: tdn	GND_H2O	RR
DINITROTOLUENE, 2,4-		1.36E-01	7.34E-01
HEXAHYDRO-1,3,5-TRINITRO-1,3,5-TRIAZINE		3.03E-02	1.63E-01
BIS(2-ETHYLHEXYL)PHTHALATE		1.11E-02	5.97E-02
BERYLLIUM		6.88E-03	3.71E-02
TRINITROTOLUENE, 2,4,6-		1.12E-03	6.05E-03
BENZENE		4.64E-05	2.50E-04
CHLOROFORM		1.22E-05	6.58E-05
DINITROTOLUENE, 2,6-		* 0.00E+00	0.00E+00
BENZO(A)PYRENE		* 0.00E+00	0.00E+00
POLYCHLORINATED BIPHENYLS		* 0.00E+00	0.00E+00
CADMIUM		* NA	NA
CHROMIUM(VI)		NA	NA
ARSENIC, INORGANIC		NA	NA
TOTAL RISK FACTOR		1.85E-01	1.00E+00

WORKSHEET W-3 RISK FACTORS & RELATIVE RISK BY MEDIA - PC GROUP
 "" INDICATES NO DATA. "NA" INDICATES NO TOXICITY VALUE.

CHEMNAME	SITE: tdn	SUR_H2O	RR
HEXAHYDRO-1,3,5-TRINITRO-1,3,5-TRIAZINE		1.10E-01	9.81E-01
BERYLLIUM		2.15E-03	1.92E-02
CHLOROFORM		* 0.00E+00	0.00E+00
BENZO(A)PYRENE		* 0.00E+00	0.00E+00
BIS(2-ETHYLHEXYL)PHTHALATE		* 0.00E+00	0.00E+00
POLYCHLORINATED BIPHENYLS		* 0.00E+00	0.00E+00
BENZENE		* 0.00E+00	0.00E+00
DINITROTOLUENE, 2,6-		* 0.00E+00	0.00E+00
TRINITROTOLUENE, 2,4,6-		* 0.00E+00	0.00E+00
DINITROTOLUENE, 2,4-		* 0.00E+00	0.00E+00
CADMIUM		NA	NA
CHROMIUM(VI)		NA	NA
ARSENIC, INORGANIC		NA	NA
TOTAL RISK FACTOR		1.12E-01	1.00E+00

WORKSHEET W-3 RISK FACTORS & RELATIVE RISK BY MEDIA - PC GROUP
 "##" INDICATES NO DATA. "NA" INDICATES NO TOXICITY VALUE.

CHEMNAME	SITE: tdn	SOIL	RR
TRINITROTOLUENE, 2,4,6-		9.61E+04	9.96E-01
DINITROTOLUENE, 2,6-		2.04E+02	2.11E-03
HEXAHYDRO-1,3,5-TRINITRO-1,3,5-TRIAZINE		1.10E+02	1.14E-03
DINITROTOLUENE, 2,4-		5.44E+01	5.64E-04
BERYLLIUM		1.29E+01	1.34E-04
BENZO(A)PYRENE		3.82E+00	3.96E-05
POLYCHLORINATED BIPHENYLS		1.67E+00	1.73E-05
BIS(2-ETHYLHEXYL)PHTHALATE		6.80E-02	7.05E-07
BENZENE		* 0.00E+00	0.00E+00
CHLOROFORM		* 0.00E+00	0.00E+00
CADMIUM		NA	NA
CHROMIUM(VI)		NA	NA
ARSENIC, INORGANIC		NA	NA
TOTAL RISK FACTOR		9.65E+04	1.00E+00

WORKSHEET W-3 RISK FACTORS & RELATIVE RISK by MEDIA - PC GROUP
 "" INDICATES NO DATA. "NA" INDICATES NO TOXICITY VALUE.

CHEMNAME	SITE: tdn	SEDIM	RR
BERYLLIUM		3.01E-01	1.00E+00
POLYCHLORINATED BIPHENYLS		* 0.00E+00	0.00E+00
BIS(2-ETHYLHEXYL)PHTHALATE		* 0.00E+00	0.00E+00
BENZENE		* 0.00E+00	0.00E+00
DINITROTOLUENE, 2,4-		* 0.00E+00	0.00E+00
CHLOROFORM		* 0.00E+00	0.00E+00
BENZO(A)PYRENE		* 0.00E+00	0.00E+00
HEXAHYDRO-1,3,5-TRINITRO-1,3,5-TRIAZINE		* 0.00E+00	0.00E+00
DINITROTOLUENE, 2,6-		* 0.00E+00	0.00E+00
TRINITROTOLUENE, 2,4,6-		* 0.00E+00	0.00E+00
CADMIUM		* NA	NA
CHROMIUM(VI)		NA	NA
ARSENIC, INORGANIC		NA	NA
TOTAL RISK FACTOR		3.01E-01	1.00E+00

WORKSHEET M-3 RISK FACTORS & RELATIVE RISK BY MEDIA - PC GROUP
 "" INDICATES NO DATA. "NA" INDICATES NO TOXICITY VALUE.

CHEMNAME	SITE:	tdh	GND_H2O	RR	SUR_H2O	RR	SOIL	RR	SEDIM	RR	AIR	RR
BERYLLIUM			6.88E-03	3.71E-02	2.15E-03	1.92E-02	1.29E+01	1.34E-04	3.01E-01	1.00E+00	* 0.00E+00	
POLYCHLORINATED BIPHENYLS*			0.00E+00	0.00E+00	* 0.00E+00	0.00E+00	1.67E+00	1.73E-05	* 0.00E+00	0.00E+00	* NA	
BIS(2-ETHYLHEXYL)PHTHALAT			1.11E-02	5.97E-02	* 0.00E+00	0.00E+00	6.80E-02	7.05E-07	* 0.00E+00	0.00E+00	* NA	
BENZENE			4.64E-05	2.50E-04	* 0.00E+00	0.00E+00	* 0.00E+00	0.00E+00	* 0.00E+00	0.00E+00	* 0.00E+00	
DINITROTOLUENE, 2,4-			1.36E-01	7.34E-01	* 0.00E+00	0.00E+00	5.44E+01	5.64E-04	* 0.00E+00	0.00E+00	* NA	
CHLOROFORM			1.22E-05	6.58E-05	* 0.00E+00	0.00E+00	* 0.00E+00	0.00E+00	* 0.00E+00	0.00E+00	* 0.00E+00	
BENZO(A)PYRENE			* 0.00E+00	0.00E+00	* 0.00E+00	0.00E+00	3.82E+00	3.96E-05	* 0.00E+00	0.00E+00	* 0.00E+00	
HEXAHYDRO-1,3,5-TRINITRO-			3.03E-02	1.63E-01	1.10E-01	9.81E-01	1.10E+02	1.14E-03	* 0.00E+00	0.00E+00	* NA	
DINITROTOLUENE, 2,6-			* 0.00E+00	0.00E+00	* 0.00E+00	0.00E+00	2.04E+02	2.11E-03	* 0.00E+00	0.00E+00	* NA	
TRINITROTOLUENE, 2,4,6-			1.12E-03	6.05E-03	* 0.00E+00	0.00E+00	9.61E+04	9.96E-01	* 0.00E+00	0.00E+00	* NA	
CADMIUM			* NA	NA	NA	NA	NA	NA	NA	NA	* 0.00E+00	
CHROMIUM(VI)			NA	NA	NA	NA	NA	NA	NA	NA	* 0.00E+00	
ARSENIC, INORGANIC			NA	NA	NA	NA	NA	NA	NA	NA	* 0.00E+00	
TOTAL RISK FACTOR			1.85E-01	1.00E+00	1.12E-01	1.00E+00	9.65E+04	1.00E+00	3.01E-01	1.00E+00	0.00E+00	

WORKSHEET W-4 RISK FACTORS & RELATIVE RISK BY MEDIA - NC GROUP
 "" INDICATES NO DATA. "NA" INDICATES NO TOXICITY VALUE.

CHEMNAME	SITE: tdn	GND_H2O	RR
NITRITE		3.05E+04	9.20E-01
TRINITROBENZENE, 1,3,5-		2.00E+03	6.04E-02
ARSENIC, INORGANIC		3.67E+02	1.11E-02
HEXAHYDRO-1,3,5-TRINITRO-1,3,5-TRIAZINE		9.17E+01	2.77E-03
TRINITROTOLUENE, 2,4,6-		7.48E+01	2.26E-03
BIS(2-ETHYLHEXYL)PHTHALATE		3.95E+01	1.19E-03
FLUORIDE		1.67E+01	5.03E-04
NICKEL (METALLIC)		1.47E+01	4.44E-04
ZINC (METALLIC)		1.22E+01	3.67E-04
CHROMIUM(VI)		1.04E+01	3.13E-04
BARIUM		6.97E+00	2.10E-04
SELENIUM		1.76E+00	5.31E-05
MERCURY, INORGANIC		6.67E-01	2.01E-05
NITRATE		6.25E-01	1.89E-05
DICHLOROETHYLENE, 1,2-T-		5.60E-01	1.69E-05
SILVER		5.20E-01	1.57E-05
OCTAHYDRO-1,3,5,7-TETRAHYDRO-1,3,5,7-TETRA		4.64E-01	1.40E-05
BERYLLIUM		3.20E-01	9.66E-06
CHLOROFORM		2.00E-01	6.04E-06
TETRACHLOROETHYLENE		1.10E-01	3.32E-06
TOLUENE		6.50E-02	1.96E-06
CHROMIUM(III)		5.19E-02	1.57E-06
BENZYL ALCOHOL		2.67E-02	8.05E-07
PHENOL		5.00E-03	1.51E-07
TRICHLOROETHANE, 1,1,1-	*	0.00E+00	0.00E+00
TRINITROPHENYLMETHYLNITRAMINE	*	0.00E+00	0.00E+00
CADMIUM	*	0.00E+00	0.00E+00
BUTYL BENZYL PHTHALATE	*	0.00E+00	0.00E+00
PYRENE	*	0.00E+00	0.00E+00
OCTYL PHTHALATE, DI-N-	*	0.00E+00	0.00E+00
BENZALDEHYDE	*	0.00E+00	0.00E+00
FLUORANTHENE	*	0.00E+00	0.00E+00
CYANIDE (CN-)	*	0.00E+00	0.00E+00
MANGANESE	*	0.00E+00	0.00E+00
ANTIMONY (METALLIC)	*	0.00E+00	0.00E+00
TOTAL RISK FACTOR		3.31E+04	1.00E+00

WORKSHEET V-4 RISK FACTORS & RELATIVE RISK BY MEDIA - NC GROUP
 "" INDICATES NO DATA. "NA" INDICATES NO TOXICITY VALUE.

CHEMNAME	SITE: tdn	SUR_H2O	RR
HEXAHYDRO-1,3,5-TRINITRO-1,3,5-TRIAZINE		3.33E+02	7.98E-01
ANTIMONY (METALLIC)		2.80E+01	6.71E-02
FLUORIDE		1.67E+01	3.99E-02
CADMIUM		1.20E+01	2.87E-02
NITRITE		1.18E+01	2.83E-02
ARSENIC, INORGANIC		9.00E+00	2.16E-02
CHROMIUM(VI)		3.00E+00	7.19E-03
NICKEL (METALLIC)		1.00E+00	2.40E-03
BARIUM		8.71E-01	2.09E-03
NITRATE		6.25E-01	1.50E-03
CYANIDE (CN-)		5.00E-01	1.20E-03
ZINC (METALLIC)		4.00E-01	9.58E-04
BERYLLIUM		1.00E-01	2.40E-04
TRINITROPHENYLMETHYLNITRAMINE		1.00E-01	2.40E-04
SILVER		4.00E-02	9.58E-05
CHROMIUM(III)		1.50E-02	3.59E-05
TRICHLOROETHANE, 1,1,1-		* 0.00E+00	0.00E+00
BIS(2-ETHYLHEXYL)PHTHALATE		* 0.00E+00	0.00E+00
SELENIUM		* 0.00E+00	0.00E+00
BUTYL BENZYL PHTHALATE		* 0.00E+00	0.00E+00
TETRACHLOROETHYLENE		* 0.00E+00	0.00E+00
PYRENE		* 0.00E+00	0.00E+00
OCTAHYDRO-1,3,5,7-TETRANITRO-1,3,5,7-TETRA*		0.00E+00	0.00E+00
OCTYL PHTHALATE, DI-N-		* 0.00E+00	0.00E+00
PHENOL		* 0.00E+00	0.00E+00
BENZALDEHYDE		* 0.00E+00	0.00E+00
DICHLOROETHYLENE, 1,2-T-		* 0.00E+00	0.00E+00
FLUORANTHENE		* 0.00E+00	0.00E+00
TOLUENE		* 0.00E+00	0.00E+00
TRINITROTOLUENE, 2,4,6-		* 0.00E+00	0.00E+00
MERCURY, INORGANIC		* 0.00E+00	0.00E+00
BENZYL ALCOHOL		* 0.00E+00	0.00E+00
CHLOROFORM		* 0.00E+00	0.00E+00
MANGANESE		* 0.00E+00	0.00E+00
TRINITROBENZENE, 1,3,5-		* 0.00E+00	0.00E+00
TOTAL RISK FACTOR		4.17E+02	1.00E+00

WORKSHEET W-4 RISK FACTORS & RELATIVE RISK by MEDIA - NC GROUP
 """" INDICATES NO DATA. "NA" INDICATES NO TOXICITY VALUE.

CHEMNAME	SITE: tdn	SOIL	RR
TRINITROTOLUENE, 2,4,6-		6.41E+09	1.00E+00
TRINITROBENZENE, 1,3,5-		1.80E+06	2.81E-04
HEXAHYDRO-1,3,5-TRINITRO-1,3,5-TRIAZINE		3.33E+05	5.20E-05
ARSENIC, INORGANIC		8.61E+04	1.34E-05
CHROMIUM(VI)		4.35E+04	6.80E-06
FLUORIDE		1.67E+04	2.60E-06
CADMIUM		1.46E+04	2.28E-06
NITRITE		1.08E+04	1.69E-06
ZINC (METALLIC)		1.04E+04	1.62E-06
NICKEL (METALLIC)		4.10E+03	6.39E-07
NITRATE		2.50E+03	3.90E-07
OCTAHYDRO-1,3,5,7-TETRANITRO-1,3,5,7-TETRA		1.90E+03	2.97E-07
MERCURY, INORGANIC		1.86E+03	2.90E-07
SELENIUM		1.16E+03	1.82E-07
BERYLLIUM		6.00E+02	9.36E-08
BIS(2-ETHYLHEXYL)PHTHALATE		2.43E+02	3.79E-08
CHROMIUM(III)		2.18E+02	3.40E-08
PYRENE		1.80E+02	2.81E-08
BENZALDEHYDE		2.30E+01	3.59E-09
FLUORANTHENE		1.53E+01	2.38E-09
TRICHLOROETHANE, 1,1,1-		7.06E+00	1.10E-09
OCTYL PHTHALATE, DI-N-		7.00E+00	1.09E-09
BUTYL BENZYL PHTHALATE		2.50E+00	3.90E-10
CYANIDE (CN-)		* 0.00E+00	0.00E+00
TRINITROPHENYLMETHYLNITRAMINE		* 0.00E+00	0.00E+00
BARIUM		* 0.00E+00	0.00E+00
SILVER		* 0.00E+00	0.00E+00
BENZYL ALCOHOL		* 0.00E+00	0.00E+00
TETRACHLOROETHYLENE		* 0.00E+00	0.00E+00
CHLOROFORM		* 0.00E+00	0.00E+00
PHENOL		* 0.00E+00	0.00E+00
TOLUENE		* 0.00E+00	0.00E+00
DICHLOROETHYLENE, 1,2-T-		* 0.00E+00	0.00E+00
MANGANESE		* 0.00E+00	0.00E+00
ANTIMONY (METALLIC)		* 0.00E+00	0.00E+00
TOTAL RISK FACTOR		6.41E+09	1.00E+00

WORKSHEET W-4 RISK FACTORS & RELATIVE RISK BY MEDIA - NC GROUP
 "**" INDICATES NO DATA. "NA" INDICATES NO TOXICITY VALUE.

CHEMNAME	SITE: tdn	SEDIM	RR
ARSENIC, INORGANIC		3.33E+04	9.38E-01
CHROMIUM(VI)		1.10E+03	3.09E-02
BARIUM		7.14E+02	2.01E-02
NICKEL (METALLIC)		2.55E+02	7.17E-03
ZINC (METALLIC)		8.10E+01	2.28E-03
SILVER		4.00E+01	1.13E-03
BERYLLIUM		1.40E+01	3.94E-04
CHROMIUM(III)		5.50E+00	1.55E-04
PYRENE		* 0.00E+00	0.00E+00
BUTYL BENZYL PHTHALATE		* 0.00E+00	0.00E+00
NITRITE		* 0.00E+00	0.00E+00
CYANIDE (CN-)		* 0.00E+00	0.00E+00
OCTAHYDRO-1,3,5,7-TETRANITRO-1,3,5,7-TETRA		0.00E+00	0.00E+00
TRINITROPHENYLMETHYLITRANINE		* 0.00E+00	0.00E+00
SELENIUM		* 0.00E+00	0.00E+00
HEXAHYDRO-1,3,5-TRINITRO-1,3,5-TRIAZINE		* 0.00E+00	0.00E+00
BIS(2-ETHYLHEXYL)PHTHALATE		* 0.00E+00	0.00E+00
TRINITROBENZENE, 1,3,5-		* 0.00E+00	0.00E+00
TRINITROTOLUENE, 2,4,6-		* 0.00E+00	0.00E+00
BENZYL ALCOHOL		* 0.00E+00	0.00E+00
FLUORANTHENE		* 0.00E+00	0.00E+00
TETRACHLOROETHYLENE		* 0.00E+00	0.00E+00
OCTYL PHTHALATE, DI-N-		* 0.00E+00	0.00E+00
CHLOROFORM		* 0.00E+00	0.00E+00
MERCURY, INORGANIC		* 0.00E+00	0.00E+00
PHENOL		* 0.00E+00	0.00E+00
FLUORIDE		* 0.00E+00	0.00E+00
TOLUENE		* 0.00E+00	0.00E+00
TRICHLOROETHANE, 1,1,1-		* 0.00E+00	0.00E+00
DICHLOROETHYLENE, 1,2-T-		* 0.00E+00	0.00E+00
CADMIUM		* 0.00E+00	0.00E+00
NITRATE		* 0.00E+00	0.00E+00
BENZALDEHYDE		* 0.00E+00	0.00E+00
MANGANESE		* 0.00E+00	0.00E+00
ANTIMONY (METALLIC)		* 0.00E+00	0.00E+00
TOTAL RISK FACTOR		3.55E+04	1.00E+00

WORKSHEET W-4 RISK FACTORS & RELATIVE RISK BY MEDIA - NC GROUP
 "" INDICATES NO DATA. "NA" INDICATES NO TOXICITY VALUE.

CHEMNAME	SITE: tdn	GND_H2O	RR	SUR_H2O	RR	SOIL	RR	SEDIM	RR	AIR	RR
ARSENIC, INORGANIC		3.67E+02	1.11E-02	9.00E+00	2.16E-02	8.61E+04	1.34E-05	3.33E+04	9.38E-01 *	NA	NA
CHROMIUM(VI)		1.04E+01	3.13E-04	3.00E+00	7.19E-03	4.35E+04	6.80E-06	1.10E+03	3.09E-02 *	NA	NA
BARIUM		6.97E+00	2.10E-04	8.71E-01	2.09E-03 *	0.00E+00	0.00E+00	7.14E+02	2.01E-02 *	0.00E+00	0.00E+00
NICKEL (METALLIC)		1.47E+01	4.44E-04	1.00E+00	2.40E-03	4.10E+03	6.39E-07	2.55E+02	7.17E-03 *	NA	NA
ZINC (METALLIC)		1.22E+01	3.67E-04	4.00E-01	9.58E-04	1.04E+04	1.62E-06	8.10E+01	2.28E-03 *	NA	NA
SILVER		5.20E-01	1.57E-05	4.00E-02	9.58E-05 *	0.00E+00	0.00E+00	4.00E+01	1.13E-03 *	NA	NA
BERYLLIUM		3.20E-01	9.66E-06	1.00E-01	2.40E-04	6.00E+02	9.36E-08	1.40E+01	3.94E-04 *	NA	NA
CHROMIUM(III)		5.19E-02	1.57E-06	1.50E-02	3.59E-05	2.18E+02	3.40E-08	5.50E+00	1.55E-04 *	NA	NA
PYRENE		* 0.00E+00	0.00E+00 *	0.00E+00 *	0.00E+00	1.80E+02	2.81E-08 *	0.00E+00	0.00E+00 *	NA	NA
BUTYL BENZYL PHTHALATE		* 0.00E+00	0.00E+00 *	0.00E+00 *	0.00E+00	2.50E+00	3.90E-10 *	0.00E+00	0.00E+00 *	NA	NA
NITRITE		3.05E+04	9.20E-01	1.18E+01	2.83E-02	1.08E+04	1.69E-06 *	0.00E+00	0.00E+00 *	NA	NA
CYANIDE (CN-)		* 0.00E+00	0.00E+00	5.00E-01	1.20E-03 *	0.00E+00	0.00E+00	0.00E+00	0.00E+00 *	NA	NA
OCTAHYDRO-1,3,5,7-TETRAHI		4.64E-01	1.40E-05 *	0.00E+00	0.00E+00	1.90E+03	2.97E-07 *	0.00E+00	0.00E+00 *	NA	NA
TRINITROPHENYLMETHYLNITRA*		0.00E+00	0.00E+00	1.00E-01	2.40E-04 *	0.00E+00	0.00E+00	0.00E+00	0.00E+00 *	NA	NA
SELENIUM		1.76E+00	5.31E-05 *	0.00E+00	0.00E+00	1.16E+03	1.82E-07 *	0.00E+00	0.00E+00 *	NA	NA
HEXAHYDRO-1,3,5-TRINITRO-		9.17E+01	2.77E-03	3.33E+02	7.98E-01	3.33E+05	5.20E-05 *	0.00E+00	0.00E+00 *	NA	NA
BIS(2-ETHYLHEXYL)PHTHALAT		3.95E+01	1.19E-03 *	0.00E+00	0.00E+00	2.43E+02	3.79E-08 *	0.00E+00	0.00E+00 *	NA	NA
TRINITROBENZENE, 1,3,5-		2.00E+03	6.04E-02 *	0.00E+00	0.00E+00	1.80E+06	2.81E-04 *	0.00E+00	0.00E+00 *	NA	NA
TRINITROTOLUENE, 2,4,6-		7.48E+01	2.26E-03 *	0.00E+00	0.00E+00	6.41E+09	1.00E+00 *	0.00E+00	0.00E+00 *	NA	NA
BENZYL ALCOHOL		2.67E-02	8.05E-07 *	0.00E+00	0.00E+00 *	0.00E+00	0.00E+00	0.00E+00	0.00E+00 *	NA	NA
FLUORANTHENE		* 0.00E+00	0.00E+00 *	0.00E+00	0.00E+00	1.53E+01	2.38E-09 *	0.00E+00	0.00E+00 *	NA	NA
TETRACHLOROETHYLENE		1.10E-01	3.32E-06 *	0.00E+00	0.00E+00 *	0.00E+00	0.00E+00	0.00E+00	0.00E+00 *	NA	NA
OCTYL PHTHALATE, DI-N-		* 0.00E+00	0.00E+00 *	0.00E+00	0.00E+00	7.00E+00	1.09E-09 *	0.00E+00	0.00E+00 *	NA	NA
CHLOROFORM		2.00E-01	6.04E-06 *	0.00E+00	0.00E+00 *	0.00E+00	0.00E+00	0.00E+00	0.00E+00 *	NA	NA
MERCURY, INORGANIC		6.67E-01	2.01E-05 *	0.00E+00	0.00E+00	1.86E+03	2.90E-07 *	0.00E+00	0.00E+00 *	0.00E+00	0.00E+00
PHENOL		5.00E-03	1.51E-07 *	0.00E+00	0.00E+00 *	0.00E+00	0.00E+00	0.00E+00	0.00E+00 *	NA	NA
FLUORIDE		1.67E+01	5.03E-04	1.67E+01	3.99E-02	1.67E+04	2.60E-06 *	0.00E+00	0.00E+00 *	NA	NA
TOLUENE		6.50E-02	1.96E-06 *	0.00E+00	0.00E+00 *	0.00E+00	0.00E+00	0.00E+00	0.00E+00 *	0.00E+00	0.00E+00
TRICHLOROETHANE, 1,1,1-		* 0.00E+00	0.00E+00 *	0.00E+00	0.00E+00	7.06E+00	1.10E-09 *	0.00E+00	0.00E+00 *	0.00E+00	0.00E+00
DICHLOROETHYLENE, 1,2-T-		5.60E-01	1.69E-05 *	0.00E+00	0.00E+00 *	0.00E+00	0.00E+00	0.00E+00	0.00E+00 *	NA	NA
CADMIUM		* 0.00E+00	0.00E+00	1.20E+01	2.87E-02	1.46E+04	2.28E-06 *	0.00E+00	0.00E+00 *	NA	NA
NITRATE		6.23E-01	1.89E-05	6.25E-01	1.50E-03	2.50E+03	3.90E-07 *	0.00E+00	0.00E+00 *	NA	NA
BENZALDEHYDE		* 0.00E+00	0.00E+00 *	0.00E+00 *	0.00E+00	2.30E+01	3.59E-09 *	0.00E+00	0.00E+00 *	NA	NA
MANGANESE		* 0.00E+00	0.00E+00 *	0.00E+00 *	0.00E+00 *	0.00E+00	0.00E+00	0.00E+00	0.00E+00 *	0.00E+00	0.00E+00
ANTIMONY (METALLIC)		* 0.00E+00	0.00E+00	2.80E+01	6.71E-02 *	0.00E+00	0.00E+00 *	0.00E+00	0.00E+00 *	NA	NA
TOTAL RISK FACTOR		3.31E+04	1.00E+00	4.17E+02	1.00E+00	6.41E+09	1.00E+00	3.55E+04	1.00E+00	0.00E+00	0.00E+00

WORKSHEET V-5 RANK & RELATIVE RISK BY MEDIA - PC GROUP
 *** INDICATES NO DATA. "NA" INDICATES NO TOXICITY VALUE.

CHEMNAME	SITE: tch	GND_H2O		SUR_H2O		SOIL		SEDIM		AIR	
		RR	RANK	RR	RANK	RR	RANK	RR	RANK	RR	RANK
ARSENIC, INORGANIC		NA	NA	NA	NA	NA	NA	NA	NA	NA	NA
BENZENE		2.50E-04	6	* 0.00E+00	NA	* 0.00E+00	NA	* 0.00E+00	NA	*	*
BENZ(A)PYRENE		* 0.00E+00	NA	* 0.00E+00	NA	3.96E-05	6	* 0.00E+00	NA	*	*
BERYLLIUM		3.71E-02	4	1.92E-02	2	1.34E-04	5	1.00E+00	1	*	*
BIS(2-ETHYLHEXYL)PHTHALATE		5.97E-02	3	* 0.00E+00	NA	7.05E-07	8	* 0.00E+00	NA	*	*
CADIUM		NA	NA	NA	NA	NA	NA	NA	NA	NA	NA
CHLOROFORM		6.58E-05	7	* 0.00E+00	NA	* 0.00E+00	NA	* 0.00E+00	NA	*	*
CHROMIUM(VI)		NA	NA	NA	NA	NA	NA	NA	NA	NA	NA
DINITROTOLUENE, 2,4-		7.34E-01	1	* 0.00E+00	NA	5.64E-04	4	* 0.00E+00	NA	*	*
DINITROTOLUENE, 2,6-		* 0.00E+00	NA	* 0.00E+00	NA	2.11E-03	2	* 0.00E+00	NA	*	*
HEXAHYDRO-1,3,5-TRINITRO-1,3,5-TRIA		1.63E-01	2	9.81E-01	1	1.14E-03	3	* 0.00E+00	NA	*	*
POLYCHLORINATED BIPIHENYLS		* 0.00E+00	NA	* 0.00E+00	NA	1.73E-05	7	* 0.00E+00	NA	*	*
TRINITROTOLUENE, 2,4,6-		6.05E-03	5	* 0.00E+00	NA	9.96E-01	1	* 0.00E+00	NA	*	*

WORKSHEET M-6 RANK & RELATIVE RISK BY MEDIA - HC GROUP
 "NA" INDICATES NO DATA. "NA" INDICATES NO TOXICITY VALUE.

CHEMNAME	SITE: tdn	GND_H2O RR	RANK	SUR_H2O RR	RANK	SOIL RR	RANK	SEDIM RR	RANK	AIR RR	RANK
ANTIMONY (METALLIC)		* 0.00E+00		6.71E-02	2	* 0.00E+00		* 0.00E+00	*		*
ARSENIC, INORGANIC		1.11E-02	3	2.16E-02	6	1.34E-05	4	9.38E-01	1		1
BARIUM		2.10E-04	11	2.09E-03	9	* 0.00E+00		2.01E-02	3		3
BENZALDEHYDE		* 0.00E+00		* 0.00E+00		3.59E-09	19	* 0.00E+00	*		*
BENZYL ALCOHOL		8.05E-07	23	* 0.00E+00		* 0.00E+00		* 0.00E+00	*		*
BERYLLIUM		9.66E-06	18	2.40E-04	13	9.36E-08	15	3.94E-04	7		7
BIS(2-ETHYLHEXYL)PHTHALATE		1.19E-03	6	* 0.00E+00		3.79E-08	16	* 0.00E+00	*		*
BUTYL BENZYL PHTHALATE		* 0.00E+00		* 0.00E+00		3.90E-10	23	* 0.00E+00	*		*
CADMIUM		* 0.00E+00		2.87E-02	4	2.28E-06	7	* 0.00E+00	*		*
CHLOROFORM		6.04E-06	19	* 0.00E+00		* 0.00E+00		* 0.00E+00	*		*
CHROMIUM(III)		1.57E-06	22	3.59E-05	16	3.40E-08	17	1.55E-04	8		8
CHROMIUM(VI)		3.13E-04	10	7.19E-03	7	6.80E-06	5	3.09E-02	2		2
CYANIDE (CN-)		* 0.00E+00		1.20E-03	11	* 0.00E+00		* 0.00E+00	*		*
DICHLOROETHYLENE, 1,2-T-		1.69E-05	15	* 0.00E+00		* 0.00E+00		* 0.00E+00	*		*
FLUORANTHENE		* 0.00E+00		* 0.00E+00		2.38E-09	20	* 0.00E+00	*		*
FLUORIDE		5.03E-04	7	3.99E-02	3	2.60E-06	6	* 0.00E+00	*		*
HEXAHYDRO-1,3,5-TRINITRO-1,3,5-TRIA		2.77E-03	4	7.98E-01	1	5.20E-05	3	* 0.00E+00	*		*
MANGANESE		* 0.00E+00		* 0.00E+00		* 0.00E+00		* 0.00E+00	*		*
MERCURY, INORGANIC		2.01E-05	13	* 0.00E+00		2.90E-07	13	* 0.00E+00	*		*
NICKEL (METALLIC)		4.44E-04	8	2.40E-03	8	6.39E-07	10	7.17E-03	4		4
NITRATE		1.89E-05	14	1.50E-03	10	3.90E-07	11	* 0.00E+00	*		*
NITRITE		9.20E-01	1	2.83E-02	5	1.69E-06	8	* 0.00E+00	*		*
OCTAHYDRO-1,3,5,7-TETRAZINOTRO-1,3,5,		1.40E-05	17	* 0.00E+00		2.97E-07	12	* 0.00E+00	*		*
OCTYL PHTHALATE, DI-N-		* 0.00E+00		* 0.00E+00		1.09E-09	22	* 0.00E+00	*		*
PHENOL		1.51E-07	24	* 0.00E+00		* 0.00E+00		* 0.00E+00	*		*
PYRENE		* 0.00E+00		* 0.00E+00		2.81E-08	18	* 0.00E+00	*		*
SELENIUM		5.31E-05	12	* 0.00E+00		1.82E-07	14	* 0.00E+00	*		*
SILVER		1.57E-05	16	9.58E-05	15	* 0.00E+00		1.13E-03	6		6
TETRACHLOROETHYLENE		3.32E-06	20	* 0.00E+00		* 0.00E+00		* 0.00E+00	*		*
TOLUENE		1.96E-06	21	* 0.00E+00		* 0.00E+00		* 0.00E+00	*		*
TRICHLOROETHANE, 1,1,1-		* 0.00E+00		* 0.00E+00		1.10E-09	21	* 0.00E+00	*		*
TRINITROBENZENE, 1,3,5-		6.04E-02	2	* 0.00E+00		2.81E-04	2	* 0.00E+00	*		*
TRINITROPHENYLMETHYLNITRAMINE		* 0.00E+00		2.40E-04	14	* 0.00E+00		* 0.00E+00	*		*
TRINITROTOLUENE, 2,4,6-		2.26E-03	5	* 0.00E+00		1.00E+00	1	* 0.00E+00	*		*
ZINC (METALLIC)		3.67E-04	9	9.58E-04	12	1.62E-06	9	2.28E-03	5		5

APPENDIX B

Indicator Chemical Worksheets

SOUTH AREA

WORKSHEET W-1a SCORING FOR INDICATOR CHEMICAL SELECTION: CONCENTRATIONS IN WATER

CHEMNAME	SITE: tds	C/N/B	Ground Water (mg/L)		Repres.	Surface Water (mg/L)		
			Low	High		Low	High	Repres.
ACENAPHTHENE		N	0.0285	0.7500				
ACETONE		N		0.0300				
ANTHRACENE		N	0.0030	0.8740				
ANTIMONY (METALLIC)		N	0.0039	0.1430		0.0034	0.0034	
ARSENIC, INORGANIC		B	0.0031	20.0000		0.0070	0.1000	
BARIUM		N	0.0079	0.9700				
BENZENE		C	0.0003	0.0980				
BENZYL ALCOHOL		N	0.0050	0.0290				
BERYLLIUM		B	0.0002	0.0500			0.0010	
BIS(2-ETHYLHEXYL)PHTHALATE		B	0.0020	0.8100			0.0020	
BROMODICHLOROMETHANE		B		0.0032				
BUTYL BENZYL PHTHALATE		N	0.0020	0.0820				
CADMIUM		B	0.0046	0.0473				
CARBON TETRACHLORIDE		B	0.0170	0.0690				
CHLOROBENZENE		N	0.0001	0.0004				
CHLOROFORM		B	0.0008	0.0282				
CHLOROMETHANE		C	0.0010	0.0026				
CHLOROPHENOL, 2-		N	0.0790	0.0800				
CHROMIUM(III)		N	0.0050	1.8850		0.0050	0.0114	
CHROMIUM(VI)		B	0.0050	1.8850		0.0050	0.0114	
CRESOL, O-		N		0.0050				
CYANIDE (CN-)		N		0.0100				
CYCLOHEXANONE		N	0.0100	0.0900				
DDD		C						
DDE		C						
DDT		B						
DIBROMOCHLOROMETHANE		B		0.0024				
DIBUTYL PHTHALATE		N						
DICHLOROBENZENE, 1,2-		N	0.0002	0.0780				
DICHLOROBENZENE, 1,4-		B	0.0004	0.1230				
DICHLOROETHANE, 1,1-		N	0.0002	0.0028				
DICHLOROETHYLENE, 1,1-		B	0.0002	0.0004				
DICHLOROETHYLENE, 1,2-C-		N	0.0019	0.0029				
DICHLOROETHYLENE, 1,2-T-		N	0.0019	0.0029				
DICHLOROMETHANE		B	0.0062	0.0716				
DICHLOROPROPANE, 1,2-		B		0.0004				
DIETHYL PHTHALATE		N						
DINITROBENZENE, 1,3-		N	0.0010	0.0095				
DINITROTOLUENE, 2,4-		C	0.0009	0.0883				
DINITROTOLUENE, 2,6-		C	0.0163	0.0205				
ETHYLBENZENE		N	0.0012	0.0878				
FLUORANTHENE		N	0.0051	0.0773				
FLUORENE		N	0.0200	1.2000				
FLUORIDE		N	0.1350	100.0000			1.0000	
HEXAHYDRO-1,3,5-TRINITRO-1,3,5-TRIAZINE		B	0.0019	0.0158				
MANGANESE		N						
MERCURY, INORGANIC		N	0.0003	0.0009				
METHYL ISOBUTYL KETONE		N						
NAPHTHALENE		N	0.0314	3.7200				
NICKEL (METALLIC)		N	0.0050	0.1762		0.0050	0.1059	
NITRATE		N	0.0308	40.0000		1.0000	1.0000	
NITRITE		N	0.0027	18.0000		0.0400	8.6900	
NITROBENZENE		N	0.0026	0.0375				
NITROSO-DI-N-PROPYLAMINE, N-		C	0.1157	0.1198				
NITROSODIPHENYLAMINE, N-		C		0.0130				
NITROTOLUENE, O-		N						
OCTAHYDRO-1,3,5,7-TETRANITRO-1,3,5,7-TETRAZINE		N	0.0116	0.0126				
OCTYL PHTHALATE, DI-N-		N						
PENTACHLOROPHENOL		B	0.0580	0.0960				
PHENOL		N	0.0030	0.0410				
PYRENE		N	0.1132	0.1226				
SELENIUM		N	0.0033	0.2000				
SILVER		N	0.0002	1.0000		0.0002	0.0200	
TETRACHLOROETHANE, 1,1,2,2-		C						
TETRACHLOROETHYLENE		N	0.0000	0.0059				
THALLIUM (IN SOLUBLE SALTS)		*	0.0024	0.0047				
TOLUENE		N	0.0004	0.0194				
TRICHLOROETHANE, 1,1,1-		N	0.0002	0.0016				
TRICHLOROETHANE, 1,1,2-		B	0.0001	0.0002				
TRICHLOROETHYLENE		*	0.0008	0.0100				
TRINITROBENZENE, 1,3,5-		N	0.0005	0.0098			0.0043	
TRINITROPHENYLMETHYLNITRAMINE		N	0.0012	0.0190			0.0056	
TRINITROTOLUENE, 2,4,6-		B	0.0009	0.0296				
URANIUM (SOLUBLE SALTS)		N	1.1700	121.0000				
VANADIUM, METALLIC		N						

XYLENE, MIXTURE
ZINC (METALLIC)

N
N

0.0003
0.0010

2.0000
114.0000

0.0010

0.0470

WORKSHEET W-1b SCORING FOR INDICATOR CHEMICAL SELECTION: CONCENTRATIONS IN SOIL AND SEDIMENT

CHEMNAME	SITE: tds	C/N/B	Soil (mg/kg)		Repres.	Sediment (mg/kg)		
			Low	High		Low	High	Repres.
ACENAPHTHENE		N	1.1800	15.4000				
ACETONE		N	0.0130	6.7200				
ANTHRACENE		N	0.7590	1.3500				
ANTIMONY (METALLIC)		N						
ARSENIC, INORGANIC		B	6.4300	180.0000		9.2640	27.5750	
BARIUM		N	110.0000	1600.0000				
BENZENE		C	0.0060	2.6470				
BENZYL ALCOHOL		N						
BERYLLIUM		B	0.1360	6.3170		0.3690	0.4610	
BIS(2-ETHYLHEXYL)PHTHALATE		B	0.4470	1.5800				
BROMODICHLOROMETHANE		B						
BUTYL BENZYL PHTHALATE		N		0.7960				
CADMIUM		B	1.0700	53.4000		2.2600	3.2100	
CARBON TETRACHLORIDE		B						
CHLOROBENZENE		N						
CHLOROFORM		B		4.5300				
CHLOROMETHANE		C						
CHLOROPHENOL, 2-		N	3.0100	5.5200				
CHROMIUM(III)		N	1.3720	26500.0000		5.2080	260.0000	
CHROMIUM(VI)		B	1.3720	26500.0000		5.2080	260.0000	
CRESOL, O-		N						
CYANIDE (CN-)		N						
CYCLOHEXANONE		N						
DDD		C		5.4400				
DDE		C		2.5200				
DDT		B		2.6100				
DIBROMOCHLOROMETHANE		B						
DIBUTYL PHTHALATE		N		0.7000				
DICHLOROBENZENE, 1,2-		N		0.0470				
DICHLOROBENZENE, 1,4-		B	0.7820	3.3400				
DICHLOROETHANE, 1,1-		N						
DICHLOROETHYLENE, 1,1-		B						
DICHLOROETHYLENE, 1,2-C-		N						
DICHLOROETHYLENE, 1,2-T-		N						
DICHLOROMETHANE		B	0.0080	0.0940				
DICHLOROPROPANE, 1,2-		B						
DIETHYL PHTHALATE		N	9.0000	20.0000				
DINITROBENZENE, 1,3-		N	2.3600	2.5150				
DINITROTOLUENE, 2,4-		C	2.7000	4.5100				
DINITROTOLUENE, 2,6-		C	4.2200	4.4420				
ETHYLBENZENE		N	0.0230	2.3900				
FLUORANTHENE		N						
FLUORENE		N	0.4460	12.3000				
FLUORIDE		N	4.5020	1000.0000		26.2580	76.7030	
HEXAHYDRO-1,3,5-TRINITRO-1,3,5-TRIAZINE		B	4.3700	4.7600				
MANGANESE		N	26.5670	345.0020				
MERCURY, INORGANIC		N	0.0290	8638.7100		0.5320	4.6510	
METHYL ISOBUTYL KETONE		N		0.0190				
NAPHTHALENE		N	0.5500	41.6000				
NICKEL (METALLIC)		N	7.0000	247.0000		9.0360	25.7670	
NITRATE		N	4.6900	10000.0000				
NITRITE		N	31.2640	2358.9170				
NITROBENZENE		N	0.9010	9.1650				
NITROSO-DI-N-PROPYLAMINE, N-		C	2.8400	3.3000				
NITROSODIPHENYLAMINE, N-		C		0.8080				
NITROTOLUENE, O-		N	13.7000	14.8910				
OCTAHYDRO-1,3,5,7-TETRANITRO-1,3,5,7-TETRAZINE		N	4.6300	4.8700				
OCTYL PHTHALATE, DI-N-		N		1.9700				
PENTACHLOROPHENOL		B	1.1100	5.5200				
PHENOL		N	3.3400	5.5200				
PYRENE		N	5.3500	5.7600				
SELENIUM		N					39.4240	
SILVER		N	0.0630	13.5000			0.9070	
TETRACHLOROETHANE, 1,1,2,2-		C	0.0030	0.3220				
TETRACHLOROETHYLENE		N						
THALLIUM (IN SOLUBLE SALTS)		*					34.6620	
TOLUENE		N	0.0150	1.2940				
TRICHLOROETHANE, 1,1,1-		N						
TRICHLOROETHANE, 1,1,2-		B						
TRICHLOROETHYLENE		*		0.0050				
TRINITROBENZENE, 1,3,5-		N	2.0960	2.2900				
TRINITROPHENYLMETHYLNITRAMINE		N	3.7960	10.0000				
TRINITROTOLUENE, 2,4,6-		B	4.6300	5.0050				
URANIUM (SOLUBLE SALTS)		N						
VANADIUM, METALLIC		N	26.5460	81.7860				

XYLENE, MIXTURE
ZINC (METALLIC)

N
N

0.0250 2.4700
2.0000 2840.0000

128.3370 329.2730

WORKSHEET W-2 SCORING FOR INDICATOR SELECTION: TOXICITY DATA

CHEMNAME	SITE: tds	TOX CLASS	WSS	AIR
ACENAPHTHENE		NC	6.00E-02	NA
ACETONE		NC	1.00E-01	NA
ANTHRACENE		NC	3.00E-01	NA
ANTIMONY (METALLIC)		NC	4.00E-04	NA
ARSENIC, INORGANIC		PC	NA	5.00E+01
		NC	3.00E-04	NA
BARIUM		NC	7.00E-02	5.00E-04
BENZENE		PC	2.90E-02	2.90E-02
BENZYL ALCOHOL		NC	3.00E-01	NA
BERYLLIUM		PC	4.30E+00	8.40E+00
		NC	5.00E-03	NA
BIS(2-ETHYLHEXYL)PHTHALATE		PC	1.40E-02	NA
		NC	2.00E-02	NA
BROMODICHLOROMETHANE		PC	1.30E-01	NA
		NC	2.00E-02	NA
BUTYL BENZYL PHTHALATE		NC	2.00E-01	NA
CADMIUM		PC	NA	6.10E+00
		NC	5.00E-04	NA
CARBON TETRACHLORIDE		PC	1.30E-01	5.30E-02
		NC	7.00E-04	NA
CHLOROBENZENE		NC	2.00E-02	2.00E-02
CHLOROFORM		PC	6.10E-03	8.10E-02
		NC	1.00E-02	NA
CHLOROMETHANE		PC	1.30E-02	6.30E-03
CHLOROPHENOL, 2-		NC	5.00E-03	NA
CHROMIUM(III)		NC	1.00E+00	NA
CHROMIUM(VI)		PC	NA	4.10E+01
		NC	5.00E-03	NA
CRESOL, O-		NC	5.00E-02	NA
CYANIDE (CN-)		NC	2.00E-02	NA
CYCLOHEXANONE		NC	5.00E+00	NA
DDD		PC	2.40E-01	NA
DDE		PC	3.40E-01	NA
DDT		PC	3.40E-01	3.40E-01
		NC	5.00E-04	NA
DIBROMOCHLOROMETHANE		PC	8.40E-02	NA
		NC	2.00E-02	NA
DIBUTYL PHTHALATE		NC	1.00E-01	NA
DICHLOROBENZENE, 1,2-		NC	9.00E-02	2.00E-01
DICHLOROBENZENE, 1,4-		PC	2.40E-02	NA
		NC	NA	7.00E-01
DICHLOROETHANE, 1,1-		NC	1.00E-01	5.00E-01
DICHLOROETHYLENE, 1,1-		PC	6.00E-01	1.20E+00
		NC	9.00E-03	NA
DICHLOROETHYLENE, 1,2-C-		NC	1.00E-02	NA
DICHLOROETHYLENE, 1,2-T-		NC	2.00E-02	NA
DICHLOROMETHANE		PC	7.50E-03	NA
		NC	6.00E-02	3.00E+00
DICHLOROPROPANE, 1,2-		PC	6.80E-02	NA
		NC	NA	4.00E-03
DIETHYL PHTHALATE		NC	8.00E-01	NA
DINITROBENZENE, 1,3-		NC	1.00E-04	NA
DINITROTOLUENE, 2,4-		PC	6.80E-01	NA
DINITROTOLUENE, 2,6-		PC	6.80E-01	NA
ETHYLBENZENE		NC	1.00E-01	1.00E+00
FLUORANTHENE		NC	4.00E-02	NA
FLUORENE		NC	4.00E-02	NA
FLUORIDE		NC	6.00E-02	NA
HEXAHYDRO-1,3,5-TRINITRO-1,3,5-TRIAPC		NC	1.10E-01	NA
		NC	3.00E-03	NA
MANGANESE		NC	1.00E-01	4.00E-04
MERCURY, INORGANIC		NC	3.00E-04	3.00E-04
METHYL ISOBUTYL KETONE		NC	5.00E-02	8.00E-02
NAPHTHALENE		NC	4.00E-02	NA
NICKEL (METALLIC)		NC	2.00E-02	NA
NITRATE		NC	1.60E+00	NA
NITRITE		NC	1.00E-01	NA
NITROBENZENE		NC	5.00E-04	2.00E-03
NITROSO-DI-N-PROPYLAMINE, N-		PC	7.00E+00	NA
NITROSDIPHENYLAMINE, N-		PC	4.90E-03	NA
NITROTOLUENE, O-		NC	1.00E-02	NA
OCTAHYDRO-1,3,5,7-TETRANITRO-1,3,5,		NC	5.00E-02	NA
OCTYL PHTHALATE, DI-N-		NC	2.00E-02	NA
PENTACHLOROPHENOL		PC	1.20E-01	NA
		NC	3.00E-02	NA

PHENOL	NC	6.00E-01	NA
PYRENE	NC	3.00E-02	NA
SELENIUM	NC	5.00E-03	NA
SILVER	NC	5.00E-03	NA
TETRACHLOROETHANE, 1,1,2,2-	PC	2.00E-01	2.00E-01
TETRACHLOROETHYLENE	NC	1.00E-02	NA
* THALLIUM (IN SOLUBLE SALTS)	*		
TOLUENE	NC	2.00E-01	4.00E-01
TRICHLOROETHANE, 1,1,1-	NC	9.00E-02	1.00E+00
TRICHLOROETHANE, 1,1,2-	PC	5.70E-02	5.70E-02
	NC	4.00E-03	NA
* TRICHLOROETHYLENE	*		
TRINITROBENZENE, 1,3,5-	NC	5.00E-05	NA
TRINITROPHENYLMETHYLNITRAMINE	NC	1.00E-02	NA
TRINITROTOLUENE, 2,4,6-	PC	3.00E-02	NA
	NC	5.00E-04	NA
URANIUM (SOLUBLE SALTS)	NC	3.00E-03	NA
VANADIUM, METALLIC	NC	7.00E-03	NA
XYLENE, MIXTURE	NC	2.00E+00	NA
ZINC (METALLIC)	NC	2.00E-01	NA

WORKSHEET W-3 RISK FACTORS & RELATIVE RISK by MEDIA - PC GROUP
 "##" INDICATES NO DATA. "NA" INDICATES NO TOXICITY VALUE.

CHEMNAME	SITE: tds	GND_H2O	RR
NITROSO-DI-N-PROPYLAMINE, N-BERYLLIUM		8.39E-01	7.17E-01
DINITROTOLUENE, 2,4-		2.15E-01	1.84E-01
DINITROTOLUENE, 2,6-		6.00E-02	5.13E-02
PENTACHLOROPHENOL		1.39E-02	1.19E-02
BIS(2-ETHYLNEXYL)PHTHALATE		1.15E-02	9.85E-03
CARBON TETRACHLORIDE		1.13E-02	9.70E-03
DICHLOROBENZENE, 1,4-BENZENE		8.97E-03	7.67E-03
HEXAHYDRO-1,3,5-TRINITRO-1,3,5-TRIAZINE		2.95E-03	2.52E-03
TRINITROTOLUENE, 2,4,6-DICHLOROMETHANE		2.84E-03	2.43E-03
BROMODICHLOROMETHANE		1.74E-03	1.49E-03
DICHLOROETHYLENE, 1,1-DIBROMOCHLOROMETHANE		8.88E-04	7.59E-04
CHLOROFORM		5.37E-04	4.59E-04
NITROSDIPHENYLAMINE, N-CHLOROMETHANE		4.16E-04	3.56E-04
DICHLOROPROPANE, 1,2-TRICHLOROETHANE, 1,1,2-TETRACHLOROETHANE, 1,1,2,2-		2.40E-04	2.05E-04
DDT		2.02E-04	1.72E-04
DDE		1.72E-04	1.47E-04
DDD		6.37E-05	5.45E-05
ARSENIC, INORGANIC		3.38E-05	2.89E-05
CHROMIUM(VI)		2.72E-05	2.33E-05
CADMIUM		1.14E-05	9.75E-06
TOTAL RISK FACTOR		* 0.00E+00	0.00E+00
		* 0.00E+00	0.00E+00
		* 0.00E+00	0.00E+00
		* 0.00E+00	0.00E+00
		NA	NA
		NA	NA
		NA	NA
		1.17E+00	1.00E+00

WORKSHEET W-3 RISK FACTORS & RELATIVE RISK by MEDIA - PC GROUP
 "*** INDICATES NO DATA. "NA" INDICATES NO TOXICITY VALUE.

CHEMNAME	SITE: tds	SUR_H2O	RR
BERYLLIUM		4.30E-03	9.94E-01
BIS(2-ETHYLHEXYL)PHTHALATE		2.80E-05	6.47E-03
DICHLOROETHYLENE, 1,1-	*	0.00E+00	0.00E+00
CHLOROFORM	*	0.00E+00	0.00E+00
DINITROTOLUENE, 2,6-	*	0.00E+00	0.00E+00
NITROSODIPHENYLAMINE, N-	*	0.00E+00	0.00E+00
DINITROTOLUENE, 2,4-	*	0.00E+00	0.00E+00
CHLOROMETHANE	*	0.00E+00	0.00E+00
DICHLOROBENZENE, 1,4-	*	0.00E+00	0.00E+00
DICHLOROPROPANE, 1,2-	*	0.00E+00	0.00E+00
HEXAHYDRO-1,3,5-TRINITRO-1,3,5-TRIAZINE	*	0.00E+00	0.00E+00
TRICHLOROETHANE, 1,1,2-	*	0.00E+00	0.00E+00
DICHLOROMETHANE	*	0.00E+00	0.00E+00
TETRACHLOROETHANE, 1,1,2,2-	*	0.00E+00	0.00E+00
NITROSO-DI-N-PROPYLAMINE, N-	*	0.00E+00	0.00E+00
DDT	*	0.00E+00	0.00E+00
PENTACHLOROPHENOL	*	0.00E+00	0.00E+00
DDE	*	0.00E+00	0.00E+00
BENZENE	*	0.00E+00	0.00E+00
DDD	*	0.00E+00	0.00E+00
BROMODICHLOROMETHANE	*	0.00E+00	0.00E+00
CARBON TETRACHLORIDE	*	0.00E+00	0.00E+00
TRINITROTOLUENE, 2,4,6-	*	0.00E+00	0.00E+00
DIBROMOCHLOROMETHANE	*	0.00E+00	0.00E+00
ARSENIC, INORGANIC		NA	NA
CHROMIUM(VI)		NA	NA
CADMIUM	*	NA	NA
TOTAL RISK FACTOR		4.33E-03	1.00E+00

WORKSHEET W-3 RISK FACTORS & RELATIVE RISK by MEDIA - PC GROUP
 *** INDICATES NO DATA. "NA" INDICATES NO TOXICITY VALUE.

CHEMNAME	SITE: tds	SOIL	RR
BERYLLIUM		2.72E+01	4.45E-01
NITROSO-DI-N-PROPYLAMINE, N-		2.31E+01	3.79E-01
DINITROTOLUENE, 2,4-		3.07E+00	5.03E-02
DINITROTOLUENE, 2,6-		3.02E+00	4.95E-02
DDD		1.31E+00	2.14E-02
DDT		8.87E-01	1.45E-02
DDE		8.57E-01	1.40E-02
PENTACHLOROPHENOL		6.62E-01	1.09E-02
HEXAHYDRO-1,3,5-TRINITRO-1,3,5-TRIAZINE		5.24E-01	8.58E-03
TRINITROTOLUENE, 2,4,6-		1.50E-01	2.46E-03
DICHLOROBENZENE, 1,4-		8.02E-02	1.31E-03
BENZENE		7.68E-02	1.26E-03
TETRACHLOROETHANE, 1,1,2,2-		6.44E-02	1.06E-03
CHLOROFORM		2.76E-02	4.53E-04
BIS(2-ETHYLHEXYL)PHTHALATE		2.21E-02	3.63E-04
NITROSDIPHENYLAMINE, N-		3.96E-03	6.49E-05
DICHLOROMETHANE		7.05E-04	1.16E-05
BROMODICHLOROMETHANE	*	0.00E+00	0.00E+00
TRICHLOROETHANE, 1,1,2-	*	0.00E+00	0.00E+00
DIBROMOCHLOROMETHANE	*	0.00E+00	0.00E+00
DICHLOROETHYLENE, 1,1-	*	0.00E+00	0.00E+00
CARBON TETRACHLORIDE	*	0.00E+00	0.00E+00
CHLOROMETHANE	*	0.00E+00	0.00E+00
DICHLOROPROPANE, 1,2-	*	0.00E+00	0.00E+00
ARSENIC, INORGANIC		NA	NA
CHROMIUM(VI)		NA	NA
CADMIUM		NA	NA
TOTAL RISK FACTOR		6.10E+01	1.00E+00

WORKSHEET W-3 RISK FACTORS & RELATIVE RISK by MEDIA - PC GROUP
 *** INDICATES NO DATA. "NA" INDICATES NO TOXICITY VALUE.

CHEMNAME	SITE: tds	SEDIM	RR
BERYLLIUM		1.98E+00	1.00E+00
CHLOROFORM		* 0.00E+00	0.00E+00
BIS(2-ETHYLHEXYL)PHTHALATE		* 0.00E+00	0.00E+00
NITROSODIPHENYLAMINE, N-		* 0.00E+00	0.00E+00
DINITROTOLUENE, 2,6-		* 0.00E+00	0.00E+00
DICHLOROMETHANE		* 0.00E+00	0.00E+00
DDT		* 0.00E+00	0.00E+00
BROMODICHLOROMETHANE		* 0.00E+00	0.00E+00
PENTACHLOROPHENOL		* 0.00E+00	0.00E+00
TRICHLOROETHANE, 1,1,2-		* 0.00E+00	0.00E+00
TRINITROTOLUENE, 2,4,6-		* 0.00E+00	0.00E+00
DIBROMOCHLOROMETHANE		* 0.00E+00	0.00E+00
BENZENE		* 0.00E+00	0.00E+00
DICHLOROETHYLENE, 1,1-		* 0.00E+00	0.00E+00
NITROSO-DI-N-PROPYLAMINE, N-		* 0.00E+00	0.00E+00
CARBON TETRACHLORIDE		* 0.00E+00	0.00E+00
DDD		* 0.00E+00	0.00E+00
CHLOROMETHANE		* 0.00E+00	0.00E+00
HEXAHYDRO-1,3,5-TRINITRO-1,3,5-TRIAZINE		* 0.00E+00	0.00E+00
DICHLOROPROPANE, 1,2-		* 0.00E+00	0.00E+00
TETRACHLOROETHANE, 1,1,2,2-		* 0.00E+00	0.00E+00
DDE		* 0.00E+00	0.00E+00
DICHLOROBENZENE, 1,4-		* 0.00E+00	0.00E+00
DINITROTOLUENE, 2,4-		* 0.00E+00	0.00E+00
ARSENIC, INORGANIC		NA	NA
CHROMIUM(VI)		NA	NA
CADMIUM		NA	NA
TOTAL RISK FACTOR		1.98E+00	1.00E+00

WORKSHEET W-4 RISK FACTORS & RELATIVE RISK by MEDIA - NC GROUP
 "" INDICATES NO DATA. "NA" INDICATES NO TOXICITY VALUE.

CHEMNAME	SITE: tds	GND_H2O	RR
ARSENIC, INORGANIC		6.67E+04	5.99E-01
URANIUM (SOLUBLE SALTS)		4.03E+04	3.62E-01
FLUORIDE		1.67E+03	1.50E-02
ZINC (METALLIC)		5.70E+02	5.12E-03
CHROMIUM(VI)		3.77E+02	3.39E-03
ANTIMONY (METALLIC)		3.57E+02	3.21E-03
SILVER		2.00E+02	1.80E-03
TRINITROBENZENE, 1,3,5-		1.96E+02	1.76E-03
NITRITE		1.80E+02	1.62E-03
CARBON TETRACHLORIDE		9.86E+01	8.86E-04
DINITROBENZENE, 1,3-		9.50E+01	8.54E-04
CADMIUM		9.46E+01	8.50E-04
NAPHTHALENE		9.30E+01	8.36E-04
NITROBENZENE		7.50E+01	6.74E-04
TRINITROTOLUENE, 2,4,6-		5.92E+01	5.32E-04
BIS(2-ETHYLHEXYL)PHTHALATE		4.05E+01	3.64E-04
SELENIUM		4.00E+01	3.59E-04
FLUORENE		3.00E+01	2.70E-04
NITRATE		2.50E+01	2.25E-04
CHLOROPHENOL, 2-		1.60E+01	1.44E-04
BARIUM		1.39E+01	1.25E-04
ACENAPHTHENE		1.25E+01	1.12E-04
BERYLLIUM		1.00E+01	8.99E-05
NICKEL (METALLIC)		8.81E+00	7.92E-05
HEXAHYDRO-1,3,5-TRINITRO-1,3,5-TRIAZINE		5.27E+00	4.73E-05
PYRENE		4.09E+00	3.67E-05
PENTACHLOROPHENOL		3.20E+00	2.88E-05
MERCURY, INORGANIC		3.00E+00	2.70E-05
ANTHRACENE		2.91E+00	2.62E-05
CHLOROFORM		2.82E+00	2.53E-05
FLUORANTHENE		1.93E+00	1.74E-05
TRINITROPHENYLMETHYLNITRAMINE		1.90E+00	1.71E-05
CHROMIUM(III)		1.89E+00	1.69E-05
DICHLOROMETHANE		1.19E+00	1.07E-05
XYLENE, MIXTURE		1.00E+00	8.99E-06
ETHYLBENZENE		8.78E-01	7.89E-06
DICHLOROBENZENE, 1,2-		8.67E-01	7.79E-06
TETRACHLOROETHYLENE		5.90E-01	5.30E-06
CYANIDE (CN-)		5.00E-01	4.49E-06
BUTYL BENZYL PHTHALATE		4.10E-01	3.68E-06
ACETONE		3.00E-01	2.70E-06
DICHLOROETHYLENE, 1,2-C-		2.90E-01	2.61E-06
OCTAHYDRO-1,3,5,7-TETRA		2.52E-01	2.26E-06
BROMODICHLOROMETHANE		1.60E-01	1.44E-06
DICHLOROETHYLENE, 1,2-T-		1.45E-01	1.30E-06
DIBROMOCHLOROMETHANE		1.20E-01	1.08E-06
CRESOL, O-		1.00E-01	8.99E-07
TOLUENE		9.70E-02	8.72E-07
BENZYL ALCOHOL		9.67E-02	8.69E-07
PHENOL		6.83E-02	6.14E-07
TRICHLOROETHANE, 1,1,2-		5.00E-02	4.49E-07
DICHLOROETHYLENE, 1,1-		4.44E-02	3.99E-07
DICHLOROETHANE, 1,1-		2.80E-02	2.52E-07
CHLOROBENZENE		2.00E-02	1.80E-07
CYCLOHEXANONE		1.80E-02	1.62E-07
TRICHLOROETHANE, 1,1,1-		1.78E-02	1.60E-07
METHYL ISOBUTYL KETONE	*	0.00E+00	0.00E+00
NITROTOLUENE, O-	*	0.00E+00	0.00E+00
DDT	*	0.00E+00	0.00E+00
MANGANESE	*	0.00E+00	0.00E+00
DIETHYL PHTHALATE	*	0.00E+00	0.00E+00
VANADIUM, METALLIC	*	0.00E+00	0.00E+00
OCTYL PHTHALATE, DI-N-	*	0.00E+00	0.00E+00
DIBUTYL PHTHALATE	*	0.00E+00	0.00E+00
DICHLOROPROPANE, 1,2-		NA	NA
DICHLOROBENZENE, 1,4-		NA	NA
TOTAL RISK FACTOR		1.11E+05	1.00E+00

WORKSHEET W-4 RISK FACTORS & RELATIVE RISK by MEDIA - NC GROUP
 *** INDICATES NO DATA. "NA" INDICATES NO TOXICITY VALUE.

CHEMNAME	SITE: tds	SUR_H2O	RR
ARSENIC, INORGANIC		3.33E+02	6.12E-01
NITRITE		8.69E+01	1.60E-01
TRINITROBENZENE, 1,3,5-		8.60E+01	1.58E-01
FLUORIDE		1.67E+01	3.06E-02
ANTIMONY (METALLIC)		8.50E+00	1.56E-02
NICKEL (METALLIC)		5.29E+00	9.72E-03
SILVER		4.00E+00	7.34E-03
CHROMIUM(VI)		2.28E+00	4.19E-03
NITRATE		6.25E-01	1.15E-03
TRINITROPHENYLMETHYLNITRAMINE		5.60E-01	1.03E-03
ZINC (METALLIC)		2.35E-01	4.31E-04
BERYLLIUM		2.00E-01	3.67E-04
BIS(2-ETHYLHEXYL)PHTHALATE		1.00E-01	1.84E-04
CHROMIUM(III)		1.14E-02	2.09E-05
DICHLOROMETHANE	*	0.00E+00	0.00E+00
ACETONE	*	0.00E+00	0.00E+00
DICHLOROETHYLENE, 1,2-C-	*	0.00E+00	0.00E+00
SELENIUM	*	0.00E+00	0.00E+00
OCTAHYDRO-1,3,5,7-TETRANITRO-1,3,5,7-TETRA*	*	0.00E+00	0.00E+00
NITROBENZENE	*	0.00E+00	0.00E+00
BROMODICHLOROMETHANE	*	0.00E+00	0.00E+00
BARIUM	*	0.00E+00	0.00E+00
DICHLOROETHYLENE, 1,2-T-	*	0.00E+00	0.00E+00
NAPHTHALENE	*	0.00E+00	0.00E+00
DIBROMOCHLOROMETHANE	*	0.00E+00	0.00E+00
HEXAHYDRO-1,3,5-TRINITRO-1,3,5-TRIAZINE	*	0.00E+00	0.00E+00
CRESOL, O-	*	0.00E+00	0.00E+00
PENTACHLOROPHENOL	*	0.00E+00	0.00E+00
TOLUENE	*	0.00E+00	0.00E+00
ANTHRACENE	*	0.00E+00	0.00E+00
BENZYL ALCOHOL	*	0.00E+00	0.00E+00
FLUORANTHENE	*	0.00E+00	0.00E+00
PHENOL	*	0.00E+00	0.00E+00
CARBON TETRACHLORIDE	*	0.00E+00	0.00E+00
TRICHLOROETHANE, 1,1,2-	*	0.00E+00	0.00E+00
XYLENE, MIXTURE	*	0.00E+00	0.00E+00
DICHLOROETHYLENE, 1,1-	*	0.00E+00	0.00E+00
DICHLOROBENZENE, 1,2-	*	0.00E+00	0.00E+00
DICHLOROETHANE, 1,1-	*	0.00E+00	0.00E+00
CYANIDE (CN-)	*	0.00E+00	0.00E+00
CHLOROBENZENE	*	0.00E+00	0.00E+00
TRINITROTOLUENE, 2,4,6-	*	0.00E+00	0.00E+00
CYCLOHEXANONE	*	0.00E+00	0.00E+00
CHLOROPHENOL, 2-	*	0.00E+00	0.00E+00
TRICHLOROETHANE, 1,1,1-	*	0.00E+00	0.00E+00
CADMIUM	*	0.00E+00	0.00E+00
METHYL ISOBUTYL KETONE	*	0.00E+00	0.00E+00
MERCURY, INORGANIC	*	0.00E+00	0.00E+00
NITROTOLUENE, O-	*	0.00E+00	0.00E+00
DINITROBENZENE, 1,3-	*	0.00E+00	0.00E+00
DDT	*	0.00E+00	0.00E+00
ETHYLBENZENE	*	0.00E+00	0.00E+00
MANGANESE	*	0.00E+00	0.00E+00
BUTYL BENZYL PHTHALATE	*	0.00E+00	0.00E+00
DIETHYL PHTHALATE	*	0.00E+00	0.00E+00
ACENAPHTHENE	*	0.00E+00	0.00E+00
VANADIUM, METALLIC	*	0.00E+00	0.00E+00
CHLOROFORM	*	0.00E+00	0.00E+00
OCTYL PHTHALATE, DI-N-	*	0.00E+00	0.00E+00
TETRACHLOROETHYLENE	*	0.00E+00	0.00E+00
DIBUTYL PHTHALATE	*	0.00E+00	0.00E+00
PYRENE	*	0.00E+00	0.00E+00
FLUORENE	*	0.00E+00	0.00E+00
URANIUM (SOLUBLE SALTS)	*	0.00E+00	0.00E+00
DICHLOROPROPANE, 1,2-	*	NA	NA
DICHLOROBENZENE, 1,4-	*	NA	NA
TOTAL RISK FACTOR		5.45E+02	1.00E+00

WORKSHEET W-4 RISK FACTORS & RELATIVE RISK by MEDIA - NC GROUP
 "" INDICATES NO DATA. "NA" INDICATES NO TOXICITY VALUE.

CHEMNAME	SITE: tds	SOIL	RR
MERCURY, INORGANIC		2.88E+07	8.21E-01
CHROMIUM(VI)		5.30E+06	1.51E-01
ARSENIC, INORGANIC		6.00E+05	1.71E-02
CADMIUM		1.07E+05	3.05E-03
TRINITROBENZENE, 1,3,5-		4.58E+04	1.31E-03
CHROMIUM(III)		2.65E+04	7.56E-04
DINITROBENZENE, 1,3-		2.52E+04	7.17E-04
NITRITE		2.36E+04	6.73E-04
BARIUM		2.29E+04	6.52E-04
NITROBENZENE		1.83E+04	5.23E-04
FLUORIDE		1.67E+04	4.75E-04
ZINC (METALLIC)		1.42E+04	4.05E-04
NICKEL (METALLIC)		1.24E+04	3.52E-04
VANADIUM, METALLIC		1.17E+04	3.33E-04
TRINITROTOLUENE, 2,4,6-		1.00E+04	2.86E-04
NITRATE		6.25E+03	1.78E-04
DDT		5.22E+03	1.49E-04
MANGANESE		3.45E+03	9.84E-05
SILVER		2.70E+03	7.70E-05
HEXAHYDRO-1,3,5-TRINITRO-1,3,5-TRIAZINE		1.59E+03	4.53E-05
NITROTOLUENE, O-		1.49E+03	4.25E-05
BERYLLIUM		1.26E+03	3.60E-05
CHLOROPHENOL, 2-		1.10E+03	3.15E-05
NAPHTHALENE		1.04E+03	2.97E-05
TRINITROPHENYLMETHYLNITRAMINE		1.00E+03	2.85E-05
CHLOROFORM		4.53E+02	1.29E-05
FLUORENE		3.08E+02	8.77E-06
ACENAPHTHENE		2.57E+02	7.32E-06
PYRENE		1.92E+02	5.48E-06
PENTACHLOROPHENOL		1.84E+02	5.25E-06
OCTYL PHTHALATE, DI-N-		9.85E+01	2.81E-06
OCTAHYDRO-1,3,5,7-TETRA-1,3,5,7-TETRA		9.74E+01	2.78E-06
BIS(2-ETHYLHEXYL)PHTHALATE		7.90E+01	2.25E-06
ACETONE		6.72E+01	1.92E-06
DIETHYL PHTHALATE		2.50E+01	7.13E-07
ETHYLBENZENE		2.39E+01	6.82E-07
PHENOL		9.20E+00	2.62E-07
DIBUTYL PHTHALATE		7.00E+00	2.00E-07
TOLUENE		6.47E+00	1.85E-07
ANTHRACENE		4.50E+00	1.28E-07
BUTYL BENZYL PHTHALATE		3.98E+00	1.14E-07
DICHLOROMETHANE		1.57E+00	4.47E-08
XYLENE, MIXTURE		1.24E+00	3.52E-08
DICHLOROBENZENE, 1,2-		5.22E-01	1.49E-08
METHYL ISOBUTYL KETONE		3.80E-01	1.08E-08
CARBON TETRACHLORIDE	*	0.00E+00	0.00E+00
DIBROMOCHLOROMETHANE	*	0.00E+00	0.00E+00
TRICHLOROETHANE, 1,1,1-	*	0.00E+00	0.00E+00
DICHLOROETHYLENE, 1,2-T-	*	0.00E+00	0.00E+00
CHLOROBENZENE	*	0.00E+00	0.00E+00
BROMODICHLOROMETHANE	*	0.00E+00	0.00E+00
DICHLOROETHANE, 1,1-	*	0.00E+00	0.00E+00
TETRACHLOROETHYLENE	*	0.00E+00	0.00E+00
TRICHLOROETHANE, 1,1,2-	*	0.00E+00	0.00E+00
SELENIUM	*	0.00E+00	0.00E+00
BENZYL ALCOHOL	*	0.00E+00	0.00E+00
DICHLOROETHYLENE, 1,2-C-	*	0.00E+00	0.00E+00
CYCLOHEXANONE	*	0.00E+00	0.00E+00
ANTIMONY (METALLIC)	*	0.00E+00	0.00E+00
DICHLOROETHYLENE, 1,1-	*	0.00E+00	0.00E+00
URANIUM (SOLUBLE SALTS)	*	0.00E+00	0.00E+00
CRESOL, O-	*	0.00E+00	0.00E+00
FLUORANTHENE	*	0.00E+00	0.00E+00
CYANIDE (CN-)	*	0.00E+00	0.00E+00
DICHLOROPROPANE, 1,2-	*	NA	NA
DICHLOROBENZENE, 1,4-	*	NA	NA
TOTAL RISK FACTOR		3.51E+07	1.00E+00

WORKSHEET W-4 RISK FACTORS & RELATIVE RISK by MEDIA - NC GROUP
 "" INDICATES NO DATA. "NA" INDICATES NO TOXICITY VALUE.

CHEMNAME	SITE: tds	SEDIM	RR
ARSENIC, INORGANIC		9.19E+04	5.15E-01
CHROMIUM(VI)		5.20E+04	2.91E-01
MERCURY, INORGANIC		1.55E+04	8.69E-02
SELENIUM		7.88E+03	4.42E-02
CADMIUM		6.42E+03	3.60E-02
ZINC (METALLIC)		1.65E+03	9.22E-03
NICKEL (METALLIC)		1.29E+03	7.22E-03
FLUORIDE		1.28E+03	7.16E-03
CHROMIUM(III)		2.60E+02	1.46E-03
SILVER		1.81E+02	1.02E-03
BERYLLIUM		9.22E+01	5.17E-04
ACETONE	*	0.00E+00	0.00E+00
ANTHRACENE	*	0.00E+00	0.00E+00
NITROBENZENE	*	0.00E+00	0.00E+00
BUTYL BENZYL PHTHALATE	*	0.00E+00	0.00E+00
TRINITROTOLUENE, 2,4,6-	*	0.00E+00	0.00E+00
DICHLOROMETHANE	*	0.00E+00	0.00E+00
DDT	*	0.00E+00	0.00E+00
XYLENE, MIXTURE	*	0.00E+00	0.00E+00
BARIUM	*	0.00E+00	0.00E+00
DICHLOROBENZENE, 1,2-	*	0.00E+00	0.00E+00
NITROTOLUENE, O-	*	0.00E+00	0.00E+00
METHYL ISOBUTYL KETONE	*	0.00E+00	0.00E+00
CHLOROPHENOL, 2-	*	0.00E+00	0.00E+00
CARBON TETRACHLORIDE	*	0.00E+00	0.00E+00
TRINITROPHENYLMETHYLNITRAMINE	*	0.00E+00	0.00E+00
DIBROMOCHLOROMETHANE	*	0.00E+00	0.00E+00
FLUORENE	*	0.00E+00	0.00E+00
TRICHLOROETHANE, 1,1,1-	*	0.00E+00	0.00E+00
PYRENE	*	0.00E+00	0.00E+00
DICHLOROETHYLENE, 1,2-T-	*	0.00E+00	0.00E+00
OCTYL PHTHALATE, DI-N-	*	0.00E+00	0.00E+00
CHLOROBENZENE	*	0.00E+00	0.00E+00
BIS(2-ETHYLHEXYL)PHTHALATE	*	0.00E+00	0.00E+00
BROMODICHLOROMETHANE	*	0.00E+00	0.00E+00
DIETHYL PHTHALATE	*	0.00E+00	0.00E+00
DICHLOROETHANE, 1,1-	*	0.00E+00	0.00E+00
PHENOL	*	0.00E+00	0.00E+00
TETRACHLOROETHYLENE	*	0.00E+00	0.00E+00
TOLUENE	*	0.00E+00	0.00E+00
TRICHLOROETHANE, 1,1,2-	*	0.00E+00	0.00E+00
NITRATE	*	0.00E+00	0.00E+00
TRINITROBENZENE, 1,3,5-	*	0.00E+00	0.00E+00
HEXAHYDRO-1,3,5-TRINITRO-1,3,5-TRIAZINE	*	0.00E+00	0.00E+00
BENZYL ALCOHOL	*	0.00E+00	0.00E+00
NAPHTHALENE	*	0.00E+00	0.00E+00
DICHLOROETHYLENE, 1,2-C-	*	0.00E+00	0.00E+00
ACENAPHTHENE	*	0.00E+00	0.00E+00
CYCLOHEXANONE	*	0.00E+00	0.00E+00
OCTAHYDRO-1,3,5,7-TETRANITRO-1,3,5,7-TETRA	*	0.00E+00	0.00E+00
ANTIMONY (METALLIC)	*	0.00E+00	0.00E+00
ETHYLBENZENE	*	0.00E+00	0.00E+00
DICHLOROETHYLENE, 1,1-	*	0.00E+00	0.00E+00
VANADIUM, METALLIC	*	0.00E+00	0.00E+00
URANIUM (SOLUBLE SALTS)	*	0.00E+00	0.00E+00
NITRITE	*	0.00E+00	0.00E+00
CRESOL, O-	*	0.00E+00	0.00E+00
PENTACHLOROPHENOL	*	0.00E+00	0.00E+00
FLUORANTHENE	*	0.00E+00	0.00E+00
DIBUTYL PHTHALATE	*	0.00E+00	0.00E+00
CYANIDE (CN-)	*	0.00E+00	0.00E+00
CHLOROFORM	*	0.00E+00	0.00E+00
MANGANESE	*	0.00E+00	0.00E+00
DINITROBENZENE, 1,3-	*	0.00E+00	0.00E+00
DICHLOROPROPANE, 1,2-	*	NA	NA
DICHLOROBENZENE, 1,4-	*	NA	NA
TOTAL RISK FACTOR		1.78E+05	1.00E+00

WORKSHEET W-1 RANK & RELATIVE RISK BY MEDIA - PC GROUP
 "NA" INDICATES NO DATA. "NA" INDICATES NO TOXICITY VALUE.

CHEMNAME	SITE: tds	GND_H2O RR	RANK	SUR_H2O RR	SOIL RR	RANK	SEDIM RR	RANK	AIR RR	RANK
ARSENIC, INORGANIC		NA	NA	NA	NA	NA	NA	NA	*	*
BENZENE		2.43E-03	9	* 0.00E+00	1.26E-03	12	* 0.00E+00	12	*	*
BERYLLIUM		1.84E-01	2	9.94E-01	4.45E-01	1	1.00E+00	1	*	1
BIS(2-ETHYLHEXYL)PHTHALATE		9.70E-03	6	6.47E-03	3.63E-04	15	* 0.00E+00	15	*	*
BROMODICHLOROMETHANE		3.56E-04	13	* 0.00E+00	* 0.00E+00	*	* 0.00E+00	*	*	*
CADMIUM		NA	NA	NA	NA	NA	NA	NA	*	*
CARBON TETRACHLORIDE		7.67E-03	7	* 0.00E+00	* 0.00E+00	*	* 0.00E+00	*	*	*
CHLOROFORM		1.47E-04	16	* 0.00E+00	4.53E-04	14	* 0.00E+00	14	*	*
CHLOROMETHANE		2.89E-05	18	* 0.00E+00	* 0.00E+00	*	* 0.00E+00	*	*	*
CHROMIUM(VI)		NA	NA	NA	NA	NA	NA	NA	*	*
DDD		* 0.00E+00	*	* 0.00E+00	2.14E-02	5	* 0.00E+00	5	*	*
DDE		* 0.00E+00	*	* 0.00E+00	1.40E-02	7	* 0.00E+00	7	*	*
DDT		* 0.00E+00	*	* 0.00E+00	1.45E-02	6	* 0.00E+00	6	*	*
DIBROMOCHLOROMETHANE		1.72E-04	15	* 0.00E+00	* 0.00E+00	*	* 0.00E+00	*	*	*
DICHLOROBENZENE, 1,4-		2.52E-03	8	* 0.00E+00	1.31E-03	11	* 0.00E+00	11	*	*
DICHLOROETHYLENE, 1,1-		2.05E-04	14	* 0.00E+00	* 0.00E+00	*	* 0.00E+00	*	*	*
DICHLOROMETHANE		4.59E-04	12	* 0.00E+00	* 0.00E+00	*	* 0.00E+00	*	*	*
DICHLOROPROPANE, 1,2-		2.33E-05	19	* 0.00E+00	1.16E-05	17	* 0.00E+00	17	*	*
DINITROTOLUENE, 2,4-		5.13E-02	3	* 0.00E+00	* 0.00E+00	*	* 0.00E+00	*	*	*
DINITROTOLUENE, 2,6-		1.19E-02	4	* 0.00E+00	5.03E-02	3	* 0.00E+00	3	*	*
HEXAHYDRO-1,3,5-TRINITRO-1,3,5-TRIA		1.49E-03	10	* 0.00E+00	4.95E-02	4	* 0.00E+00	4	*	*
NITROSO-DI-N-PROPYLAMINE, N-		7.17E-01	1	* 0.00E+00	8.58E-03	9	* 0.00E+00	9	*	*
NITROSODIPHENYLAMINE, N-		5.45E-05	17	* 0.00E+00	3.79E-01	2	* 0.00E+00	2	*	*
PENTACHLOROPHENOL		9.85E-03	5	* 0.00E+00	6.49E-05	16	* 0.00E+00	16	*	*
TETRACHLOROETHANE, 1,1,2,2-		* 0.00E+00	*	* 0.00E+00	1.09E-02	8	* 0.00E+00	8	*	*
TRICHLOROETHANE, 1,1,2-		9.75E-06	20	* 0.00E+00	1.06E-03	13	* 0.00E+00	13	*	*
TRINITROTOLUENE, 2,4,6-		7.59E-04	11	* 0.00E+00	* 0.00E+00	*	* 0.00E+00	*	*	*
					2.46E-03	10	* 0.00E+00	10	*	*

WORKSHEET W-6 RANK & RELATIVE RISK by MEDIA - NC GROUP
 *** INDICATES NO DATA. "NA" INDICATES NO TOXICITY VALUE.

CHEMNAME	SITE: tds	GND H2O RR	RANK	SUR H2O RR	RANK	SOIL RR	RANK	SEDIM RR	RANK	AIR RR	RANK
ACENAPHTHENE		1.12E-04	22 *	0.00E+00		7.32E-06	28 *	0.00E+00	*		
ACETONE		2.70E-06	41 *	0.00E+00		1.92E-06	34 *	0.00E+00	*		
ANTHRACENE		2.62E-05	29 *	0.00E+00		1.28E-07	40 *	0.00E+00	*		
ANTIMONY (METALLIC)		3.21E-03	6	1.56E-02	5 *	0.00E+00	*	0.00E+00	*		
ARSENIC, INORGANIC		5.99E-01	1	6.12E-01	1	1.71E-02	3	5.15E-01	1 *		
BARIUM		1.25E-04	21 *	0.00E+00		6.52E-04	9 *	0.00E+00	*		
BENZYL ALCOHOL		8.69E-07	49 *	0.00E+00		0.00E+00	*	0.00E+00	*		
BERYLLIUM		8.99E-05	23	3.67E-04	12	3.60E-05	22	5.17E-04	11 *		
BIS(2-ETHYLHEXYL)PHTHALATE		3.64E-04	16	1.84E-04	13	2.25E-06	33 *	0.00E+00	*		
BROMODICHLOROMETHANE		1.44E-06	44 *	0.00E+00		0.00E+00	*	0.00E+00	*		
BUTYL BENZYL PHTHALATE		3.68E-06	40 *	0.00E+00		1.14E-07	41 *	0.00E+00	*		
CADMIUM		8.50E-04	12 *	0.00E+00		3.05E-03	4	3.60E-02	5 *		
CARBON TETRACHLORIDE		8.86E-04	10 *	0.00E+00		0.00E+00	*	0.00E+00	*		
CHLOROBENZENE		1.80E-07	54 *	0.00E+00		0.00E+00	*	0.00E+00	*		
CHLOROFORM		2.53E-05	30 *	0.00E+00		1.29E-05	26 *	0.00E+00	*		
CHLOROPHENOL, 2-		1.44E-04	20 *	0.00E+00		3.15E-05	23 *	0.00E+00	*		
CHROMIUM(III)		1.69E-05	33	2.09E-05	14	7.56E-04	6	1.46E-03	9 *		
CHROMIUM(VI)		3.39E-03	5	4.19E-03	8	1.51E-01	2	2.91E-01	2 *		
CRESOL, O-		8.99E-07	47 *	0.00E+00		0.00E+00	*	0.00E+00	*		
CYANIDE (CN-)		4.49E-06	39 *	0.00E+00		0.00E+00	*	0.00E+00	*		
CYCLOHEXANONE		1.62E-07	55 *	0.00E+00		0.00E+00	*	0.00E+00	*		
DDT		* 0.00E+00	*	0.00E+00		1.49E-04	17 *	0.00E+00	*		
DIBROMOCHLOROMETHANE		1.08E-06	46 *	0.00E+00		0.00E+00	*	0.00E+00	*		
DIBUTYL PHTHALATE		* 0.00E+00	*	0.00E+00		2.00E-07	38 *	0.00E+00	*		
DICHLOROBENZENE, 1,2-		7.79E-06	37 *	0.00E+00		1.49E-08	44 *	0.00E+00	*		
DICHLOROBENZENE, 1,4-		NA	NA *	NA	NA	NA	NA *	NA	NA *		
DICHLOROETHANE, 1,1-		2.52E-07	53 *	0.00E+00		0.00E+00	*	0.00E+00	*		
DICHLOROETHYLENE, 1,1-		3.99E-07	52 *	0.00E+00		0.00E+00	*	0.00E+00	*		
DICHLOROETHYLENE, 1,2-C-		2.61E-06	42 *	0.00E+00		0.00E+00	*	0.00E+00	*		
DICHLOROETHYLENE, 1,2-T-		1.30E-06	45 *	0.00E+00		0.00E+00	*	0.00E+00	*		
DICHLOROMETHANE		1.07E-05	34 *	0.00E+00		4.47E-08	42 *	0.00E+00	*		
DICHLOROPROPANE, 1,2-		NA	NA *	NA	NA	NA	NA *	NA	NA *		
DIETHYL PHTHALATE		* 0.00E+00	*	0.00E+00		7.13E-07	35 *	0.00E+00	*		
DINITROBENZENE, 1,3-		8.54E-04	11 *	0.00E+00		7.17E-04	7 *	0.00E+00	*		
ETHYLBENZENE		7.89E-06	36 *	0.00E+00		6.82E-07	36 *	0.00E+00	*		
FLUORANTHENE		1.74E-05	31 *	0.00E+00		0.00E+00	*	0.00E+00	*		
FLUORENE		2.70E-04	18 *	0.00E+00		8.77E-06	27 *	0.00E+00	*		
FLUORIDE		1.50E-02	3	3.06E-02	4	4.75E-04	11	7.16E-03	8 *		
HEXAHYDRO-1,3,5-TRINITRO-1,3,5-TRIA		4.73E-05	25 *	0.00E+00		4.53E-05	20 *	0.00E+00	*		
MANGANESE		* 0.00E+00	*	0.00E+00		9.84E-05	18 *	0.00E+00	*		
MERCURY, INORGANIC		2.70E-05	28 *	0.00E+00		8.21E-01	1	8.69E-02	3 *		
METHYL ISOBUTYL KETONE		* 0.00E+00	*	0.00E+00		1.08E-08	45 *	0.00E+00	*		
NAPHTHALENE		8.36E-04	13 *	0.00E+00		2.97E-05	24 *	0.00E+00	*		
NICKEL (METALLIC)		7.92E-05	24	9.72E-03	6	3.52E-04	13	7.22E-03	7 *		
NITRATE		2.25E-04	19	1.15E-03	9	1.78E-04	16 *	0.00E+00	*		
NITRITE		1.62E-03	9	1.60E-01	2	6.73E-04	8 *	0.00E+00	*		
NITROBENZENE		6.74E-04	14 *	0.00E+00		5.23E-04	10 *	0.00E+00	*		
NITROTOLUENE, O-		* 0.00E+00	*	0.00E+00		4.25E-05	21 *	0.00E+00	*		
OCTAHYDRO-1,3,5,7-TETRANITRO-1,3,5,		2.26E-06	43 *	0.00E+00		2.78E-06	32 *	0.00E+00	*		
OCTYL PHTHALATE, DI-N-		* 0.00E+00	*	0.00E+00		2.81E-06	31 *	0.00E+00	*		
PENTACHLOROPHENOL		2.88E-05	27 *	0.00E+00		5.25E-06	30 *	0.00E+00	*		
PHENOL		6.14E-07	50 *	0.00E+00		2.62E-07	37 *	0.00E+00	*		
PYRENE		3.67E-05	26 *	0.00E+00		5.48E-06	29 *	0.00E+00	*		
SELENIUM		3.59E-04	17 *	0.00E+00		0.00E+00	*	4.42E-02	4 *		
SILVER		1.80E-03	7	7.34E-03	7	7.70E-05	19	1.02E-03	10 *		
TETRACHLOROETHYLENE		5.30E-06	38 *	0.00E+00		0.00E+00	*	0.00E+00	*		
TOLUENE		8.72E-07	48 *	0.00E+00		1.85E-07	39 *	0.00E+00	*		
TRICHLOROETHANE, 1,1,1-		1.60E-07	56 *	0.00E+00		0.00E+00	*	0.00E+00	*		
TRICHLOROETHANE, 1,1,2-		4.49E-07	51 *	0.00E+00		0.00E+00	*	0.00E+00	*		
TRINITROBENZENE, 1,3,5-		1.76E-03	8	1.58E-01	3	1.31E-03	5 *	0.00E+00	*		
TRINITROPHENYLMETHYLNITRAMINE		1.71E-05	32	1.03E-03	10	2.85E-05	25 *	0.00E+00	*		
TRINITROTOLUENE, 2,4,6-		5.32E-04	15 *	0.00E+00		2.86E-04	15 *	0.00E+00	*		
URANIUM (SOLUBLE SALTS)		3.62E-01	2 *	0.00E+00		0.00E+00	*	0.00E+00	*		
VANADIUM, METALLIC		* 0.00E+00	*	0.00E+00		3.33E-04	14 *	0.00E+00	*		
XYLENE, MIXTURE		8.99E-06	35 *	0.00E+00		3.52E-08	43 *	0.00E+00	*		
ZINC (METALLIC)		5.12E-03	4	4.31E-04	11	4.05E-04	12	9.22E-03	6 *		

Appendix B

Cost Estimates

List of Abbreviations Used in Cost Estimates

LF	linear foot
EA	each
LS	lump sum
M-Hrs	man-hours
CY	cubic yard
SY	square yard
AC	acre

*Table B-1. Operable Unit 5, Site 17: Institutional Controls, Cost Estimating Worksheet
(-30% to +50% Level) (All costs are rounded to nearest significant dollar
value and adjusted to January 1993 basis)*

I. Total Capital Costs						
Cost Component	Unit	Quantity	Unit Cost (\$)	Total Capital Cost (\$)	Notes	
A. Direct Capital Costs (includes labor, equipment, and materials)						
1. Access Control Fence	LF	2,100	15	31,500	Means	
2. Corner Posts	EA	4	85	340	Means	
3. Gates	EA	1	800	800	Means	
4. Braces	EA	10	30	300	Means	
Total Direct Capital Costs				32,940		
B. Indirect Capital Costs (% of Total Direct Costs)						
1. Engineering and Design	LS	5%		1,650	Experience	
2. Fees/Permits	LS	10%		3,290	Experience	
3. Contingency	LS	15%		4,940	Current Level of Detail	
Total Indirect Capital Costs		30%		9,880		
Total Capital Costs (Direct & Indirect)				43,000	(Rounded)	
II. Annual Costs						
Cost Component	Unit	Quantity per year	Unit Cost (\$)	Annual Cost (\$)	Present Worth @ 5% Discount Rate for 30 Years	Notes
Maintenance Labor	M-Hrs	16	25	400	6,150	Experience Estimate
Maintenance Material	LS	1	250	250	3,850	Experience Estimate
Total Annual Costs				650	10,000	(Rounded)

**GRAND TOTAL (CAPITAL PLUS PRESENT
WORTH OF ANNUAL COSTS)**

\$53,000

Table B-2. Operable Unit 5, Site 17: Soil Cover, Cost Estimating Worksheet
 (-30% to +50% Level) (All costs are rounded to nearest significant dollar
 value and adjusted to January 1993 basis)

I. Total Capital Costs

Cost Component	Unit	Quantity	Unit Cost (\$)	Total Capital Cost (\$)	Notes
A. Direct Capital Costs (includes labor, equipment, and materials)					
1. Haul and Place Soil	CY	6,500	4.50	29,250	Means
2. Compact	CY	6,500	1.00	6,500	Means
3. Haul and Place Gravel 2" cover	CY	1,500	9.00	13,500	Means
4. Sample and Analysis for PCBs	EA	20	400	8,000	Rust E&I
Subtotal-Capital (Labor, Equipment, and Materials)				57,250	
Additional Directs (% of Above Items)					
1. Mobilization	LS	5% of items 1-4		2,900	Experience
2. Dust Control	LS	10% of items 1-3		4,900	Experience
Total Direct Capital Costs				65,050	
B. Indirect Capital Costs (% of Total Direct Costs)					
1. Engineering	LS	5%		3,250	Experience
2. Fees/Permits	LS	5%		3,250	Experience
3. Contingency	LS	15%		9,800	Current Level of Detail
Total Indirect Capital Costs			25%	16,300	
Total Capital Costs (Direct & Indirect)				81,350	

There are no annual maintenance or operating costs for this alternative.

Table B-3. Operable Unit 5, Site 17: Stabilization, Cost Estimating Worksheet
 (-30% to +50% Level) (All costs are rounded to nearest significant dollar
 value and adjusted to January 1993 basis)

I. Total Capital Costs

Cost Component	Unit	Quantity	Unit Cost (\$)	Total Capital Cost (\$)	Notes
A. Direct Capital Costs (includes labor, equipment, and materials)					
1. Excavate	CY	13,000	1.45	18,850	Means
2. Mix Soil and Cement	CY	16,250	50.00	812,500	Means
3. Replace Mixture	CY	16,250	20.00	325,000	Means
Subtotal-Capital (Labor, Equipment, and Materials)				1,156,350	
Additional Directs (% of Above Subtotal)					
1. Mobilization	LS	5%		57,825	Experience
2. Dust Control	LS	5%		57,825	Experience
Total Direct Capital Costs				1,272,000	
B. Indirect Capital Costs (% of Total Direct Costs)					
1. Engineering and Design	LS	5%		63,600	Experience
2. Fees/Permits	LS	5%		63,600	Experience
3. Contingency	LS	25%		318,000	Current Level of Detail
Total Indirect Capital Costs		35%		445,200	
Total Capital Costs (Direct & Indirect)				1,717,200	

There are no annual costs for this alternative.

Table B-4. Operable Unit 5, Site 17: Landfill Disposal, Cost Estimating Worksheet
(-30% to +50% Level) (All costs are rounded to nearest significant dollar value and adjusted to January 1993 basis)

I. Total Capital Costs

Cost Component	Unit	Quantity	Unit Cost (\$)	Total Capital Cost (\$)	Notes
A. Direct Capital Costs (includes labor, equipment, and materials)					
1. Excavate	CY	13,000	1.45	18,850	Means
2. Load and Haul to Landfill	CY	13,000	33.75	438,750	Means
3. Landfill Testing	Truckload	800	400.00	320,000	Rust E&I
4. Backfill	CY	13,000	5.50	71,500	Means
5. Haul and Place 2" Gravel Cover	CY	500	9.00	4,500	Means
Subtotal-Capital (Labor, Equipment, and Materials)				853,600	
Additional Directs (% of Above Items 1, 2, 4, and 5)					
1. Mobilization	LS	5%		26,680	Experience
2. Dust Control	LS	10%		53,360	Experience
Total Direct Capital Costs				933,640	
B. Indirect Capital Costs (% of Total Direct Costs)					
1. Engineering	LS	5%		46,685	Experience
2. Fees/Permits	LS	5%		46,685	Experience
3. Contingency	LS	15%		140,050	Current Level of Detail
Total Indirect Capital Costs			25%	233,420	
Total Capital Costs (Direct & Indirect)				1,167,000	(Rounded)

There are no annual maintenance or operating costs for this alternative.

Table B-5. Operable Unit 5, Site 17: Incineration, Cost Estimating Worksheet
 (-30% to +50% Level) (All costs are rounded to nearest significant dollar
 value and adjusted to January 1993 basis)

I. Total Capital Costs

Cost Component	Unit	Quantity	Unit Cost (\$)	Total Capital Cost (\$)	Notes
A. Direct Capital Costs (includes labor, equipment, and materials)					
1. Excavate	CY	13,000	1.45	18,850	Means
2. Load and Haul to Landfill	CY	13,000	33.75	438,750	Means
3. Incineration	CY	13,000	1,500.00	19,500,000	Westinghouse
4. Backfill	CY	13,000	5.50	71,500	Means
5. Haul and Place 2" Gravel Cover	CY	500	9.00	4,500	Means
Subtotal-Capital (Labor, Equipment, and Materials)				20,033,600	
Additional Directs (% of Above Items 1, 2, 4, and 5)					
1. Mobilization	LS	5%		1,000,000	Experience
2. Dust Control	LS	10%		2,000,000	Experience
Total Direct Capital Costs				23,000,000	(Rounded)
B. Indirect Capital Costs (% of Total Direct Costs)					
1. Contingency	LS	15%		3,500,000	Current Level of Detail
Total Capital Costs (Direct & Indirect)				26,500,000	(Rounded)

There are no annual maintenance or operating costs for this alternative.

*Table B-6. Operable Unit 7, Site 5: Institutional Controls, Cost Estimating Worksheet
(-30% to +50% Level) (All costs are rounded to nearest significant dollar value
and adjusted to January 1993 basis)*

I. Total Capital Costs						
Cost Component	Unit	Quantity	Unit Cost (\$)	Total Capital Cost (\$)	Notes	
A. Direct Capital Costs (includes labor, equipment, and materials)						
1. Access Control Fence	LF	100	15	1,500	Means	
2. Corner Posts	EA	4	85	340	Means	
3. Gates	EA	1	800	800	Means	
4. Braces	EA	10	30	300	Means	
Total Direct Capital Costs				2,940		
B. Indirect Capital Costs (% of Total Direct Costs)						
1. Engineering and Design	LS	5%		150	Experience	
2. Fees/Permits	LS	10%		300	Experience	
3. Contingency	LS	15%		450	Current Level of Detail	
Total Indirect Capital Costs			30%	900		
Total Capital Costs (Direct & Indirect)				3,800	(Rounded)	
II. Annual Costs						
Cost Component	Unit	Quantity per year	Unit Cost (\$)	Annual Cost (\$)	Present Worth @ 5% Discount Rate for 30 Years	Notes
Maintenance Labor	M-Hrs	8	25	200	3,075	Experience Estimate
Maintenance Material	LS	1	200	200	3,075	Experience Estimate
Total Annual Costs				400	6,200	(Rounded)

GRAND TOTAL (CAPITAL PLUS PRESENT WORTH OF ANNUAL COSTS)

\$10,000

Table B-7. Operable Unit 7, Site 5: Soil Cover, Cost Estimating Worksheet
 (-30% to +50% Level) (All costs are rounded to nearest significant dollar
 value and adjusted to January 1993 basis)

I. Total Capital Costs

Cost Component	Unit	Quantity	Unit Cost (\$)	Total Capital Cost (\$)	Notes
A. Direct Capital Costs (includes Labor, equipment, and materials)					
1. Haul and Place Soil (Fill hole and cover 10'x10' area)	CY	6.5	21	135	Means
2. Compact	CY	6.5	2	15	Means
3. Haul and Place Gravel	CY	5	9	45	Means
4. Sample and Analysis for PCBs	EA	1	400	400	Rust E&I
Subtotal-Capital (Labor, Equipment, and Materials)				595	
Additional Directs (% of Above Items 1-3)					
1. Mobilization	LS	5%		10	Experience
2. Dust Control	LS	10%		20	Experience
Total Direct Capital Costs				625	
B. Indirect Capital Costs (% of Total Direct Costs)					
1. Engineering, Fees, and Contingency	LS	35%		225	Experience
Total Capital Costs (Direct & Indirect)				850	

There are no annual maintenance or operating costs for this alternative.

Table B-8. Operable Unit 7, Site 5: Stabilization, Cost Estimating Worksheet
 (-30% to +50% Level) (All costs are rounded to nearest significant dollar
 value and adjusted to January 1993 basis)

I. Total Capital Costs

Cost Component	Unit	Quantity	Unit Cost (\$)	Total Capital Cost (\$)	Notes
A. Direct Capital Costs (includes labor, equipment, and materials)					
1. Excavate	CY	20	1.45	30	Means
2. Mix Soil and Cement	CY	25	50.00	1,250	Means
3. Replace Mixture	CY	25	20.00	500	Means
Subtotal-Capital (Labor, Equipment, and Materials)				1,780	
Additional Directs (% of Above Subtotal)					
1. Mobilization	LS	5%		90	Experience
2. Dust Control	LS	5%		90	Experience
Total Direct Capital Costs				1,960	
B. Indirect Capital Costs (% of Total Direct Costs)					
1. Engineering	LS	5%		100	Experience
2. Fees/Permits	LS	5%		100	Experience
3. Contingency	LS	25%		500	Current Level of Detail
Total Indirect Capital Costs		35%		700	
Total Capital Costs (Direct & Indirect)				2,700	(Rounded)

*Table B-9. Operable Unit 7, Site 5: Landfill Disposal, Cost Estimating Worksheet
(-30% to +50% Level) (All costs are rounded to nearest significant dollar
value and adjusted to January 1993 basis)*

I. Total Capital Costs

Cost Component	Unit	Quantity	Unit Cost (\$)	Total Capital Cost (\$)	Notes
A. Direct Capital Costs (includes labor, equipment, and materials)					
1. Excavate	CY	20	1.45	30	Means
2. Load and Haul to Landfill	CY	20	33.75	675	Means
3. Landfill Testing	Truckload	2	400.00	800	Means
4. Backfill	CY	25	5.50	140	Means
5. Revegetate	SY	15	11.00	165	Rust E&I
Subtotal-Capital (Labor, Equipment, and Materials)				1,810	
Additional Directs (% of Above Items 1, 2, 4, and 5)					
1. Mobilization	LS	5%		90	Experience
2. Dust Control	LS	10%		180	Experience
Total Direct Capital Costs				2,080	
B. Indirect Capital Costs (% of Total Direct Costs)					
1. Engineering	LS	5%		100	Experience
2. Fees/Permits	LS	5%		100	Experience
3. Contingency	LS	15%		300	Current Level of Detail
Total Indirect Capital Costs		25%		500	
Total Capital Costs (Direct & Indirect)				2,600	(Rounded)

There are no annual maintenance or operating costs for this alternative.

Table B-10. Operable Unit 7, Site 5: Incineration, Cost Estimating Worksheet
 (-30% to +50% Level) (All costs are rounded to nearest significant dollar
 value and adjusted to January 1993 basis)

I. Total Capital Costs

Cost Component	Unit	Quantity	Unit Cost (\$)	Total Capital Cost (\$)	Notes
A. Direct Capital Costs (includes labor, equipment, and materials)					
1. Excavate	CY	20	1.45	30	Means
2. Load and Haul to Landfill	CY	20	33.75	675	Means
3. Incineration	CY	20	1,500.00	30,000	Westinghouse
4. Backfill	CY	25	5.50	140	Means
5. Revegetate	SY	15	11.00	165	Rust E&I
Subtotal-Capital (Labor, Equipment, and Materials)				31,011	
Additional Directs (% of Above Items 1, 2, 4, and 5)					
1. Mobilization	LS	5%		1,550	Experience
2. Dust Control	LS	10%		3,100	Experience
Total Direct Capital Costs				35,660	(Rounded)
B. Indirect Capital Costs (% of Total Direct Costs)					
1. Contingency	LS	15%		5,350	Current Level of Detail
Total Capital Costs (Direct & Indirect)				41,000	(Rounded)

There are no annual maintenance or operating costs for this alternative.

*Table B-11. Operable Unit 10, Site 41: Institutional Controls, Cost Estimating Worksheet
(-30% to +50% Level) (All costs are rounded to nearest significant dollar
value and adjusted to January 1993 basis)*

I. Total Capital Costs					
Cost Component	Unit	Quantity	Unit Cost (\$)	Total Capital Cost (\$)	Notes
A. Direct Capital Costs (includes labor, equipment, and materials)					
1. Access Control Fence	LF	900	15	13,500	Means
2. Corner Posts	EA	4	85	340	Means
3. Gates	EA	1	800	800	Means
4. Braces	EA	10	30	300	Means
Total Direct Capital Costs				14,940	
B. Indirect Capital Costs (% of Total Direct Costs)					
1. Engineering, and Design	LS	5%		750	Experience
2. Fees/Permits	LS	10%		1,500	Experience
3. Contingency	LS	15%		2,250	Current Level of Detail
Total Indirect Capital Costs		30%		4,500	
Total Capital Costs (Direct & Indirect)				19,500	(Rounded)

II. Annual Costs						
Cost Component	Unit	Quantity per year	Unit Cost (&)	Annual Cost (\$)	Present Worth @ 5% Discount Rate for 30 Years	Notes
Maintenance Labor	M-Hrs	10	25	250	3,850	Experience Estimate
Maintenance Material	LS	1	250	250	3,850	Experience Estimate
Total Annual Costs				500	7,700	(Rounded)

**GRAND TOTAL (CAPITAL PLUS PRESENT
WORTH OF ANNUAL COSTS)**

\$27,200

Table B-12. Operable Unit 10, Site 41: Excavation and Offsite Incineration of Drums and Stained Soils, Cost Estimating Worksheet (-30% to +50% Level) (All costs are rounded to nearest significant dollar value and adjusted to January 1993 basis)

I. Total Capital Costs

Cost Component	Unit	Quantity	Unit Cost (\$)	Total Capital Cost (\$)	Notes
A. Direct Capital Costs (includes Labor, equipment, and materials)					
1. Prepare and Remove Drums	Drum	26	5,000	130,000	Experience
2. Haul to Landfill	LS	1	1,000	1,000	Means
3. Characterize Wastes	LS	1	1,100	1,100	Westinghouse
4. Incinerate Drums	Drum	26	1,000	26,000	Westinghouse
Total Direct Capital Costs				158,100	
B. Indirect Capital Costs (% of Total Direct Costs)					
1. Engineering	LS	5%		8,000	Experience
2. Fees (Other than RCRA)	LS	5%		8,000	Experience
3. Contingency	LS	30%		48,000	Current Level of Detail
Total Indirect Capital Costs		40%		64,000	
Total Capital Costs (Direct & Indirect)				222,000	(Rounded)

There are no annual costs for this alternative.

Table B-13. Operable Unit 10, Site 41: Excavation and Offsite Disposal of Drums and Stained Soils, Cost Estimating Worksheet (-30% to +50% Level) (All costs are rounded to nearest significant dollar value and adjusted to January 1993 basis)

I. Total Capital Costs

Cost Component	Unit	Quantity	Unit Cost (\$)	Total Capital Cost (\$)	Notes
A. Direct Capital Costs (includes Labor, equipment, and materials)					
1. Prepare and Remove Drums	Drum	26	5,000	130,000	Experience
2. Haul to Landfill	LS	1	1,000	1,000	Means
3. Characterize Wastes	LS	1	1,100	1,100	USPCI
4. Disposal	Drum	26	225	5,050	USPCI
Total Direct Capital Costs				137,950	
B. Indirect Capital Costs (% of Total Direct Costs)					
1. Engineering	LS	5%		7,000	Experience
2. Fees (Other than RCRA)	LS	5%		7,000	Experience
3. Contingency	LS	30%		41,000	Current Level of Detail
Total Indirect Capital Costs			40%	55,000	
Total Capital Costs (Direct & Indirect)				193,000	(Rounded)

There are no annual costs for this alternative.

APPENDIX C

Correspondence Related to PCB Inspection at TEAD

November 13, 1981

PCB Inspection (PCB82-1)
Tooele Army Depot - Tooele, UT

BAH-TS

Robert W. Harding, Chief
Field Operations Section

I conducted a PCB Inspection at Tooele Army Depot on October 14, 1981, in response to three complaints received by the EPA. The complaints referred to three spills of suspected PCB liquid in buildings 659 and 677 and possible PCB exposure of three to ten workers (see attached spill reports).

I met the following criteria:

- Credentials were shown.
- Notice of Inspection and Confidentiality Notice was given to Mr. Larry Fisher.
- Receipt for Samples and Preliminary Notice of Inspection Results were mailed 10/15/81.

The following people were involved in the PCB Inspection:

Larry Fisher, Environmental Coordinator, U.S. Department of Army

Mason Walker, Technician, Environmental Services, U.S. Department of Army

Terry L. Thompson, Deputy Director of Supply, U.S. Department of Army

Captain Stephen Wilson, U.S. Army Security

Paul Hanneman, Consumer Safety Officer, EPA

I confined my inspection to the spill complaints, because Tooele had been inspected by two other EPA Inspectors.

The complaints indicated PCB liquid had been spilled in Buildings 659 and 677. I discussed these reported spills with Fisher, Walker & Thompson, and they were aware of Transformer Oil being spilled in Bldg. 659 and Bldg. 677. Fisher had taken two soil samples; Sample #JK1979 is a sample from the spill at Bldg. 677, and Sample #JK1960 was a sample from the spill in Bldg. 659. Fisher said he had received a verbal report from their lab that both spills were less than 50 ppm PCB. I wrote a letter to Sandy Ehrhardt at the U.S. Army Lab, requesting the lab results for sample numbers JK1960 and JK1979. I received their letter November 9, 1981, confirming Fisher's statement (see attachment). I also discussed the claims of worker exposure to suspected PCBs. Fisher and Walker were aware

PCB Inspection (PCB62-1)
Tooele Army Depot, Tooele, UT
Page 2

of a complaint lodged by J. Tanner through the U.S.C.G. about a PCB spill and human exposure to suspected PCB (see attachment). The U.S. Army appointed Captain Stephen Wilson to investigate the complaint and submit finding and recommendations to the Commanding Officer (see attachment). A summarization of the findings of Captain Wilson's report and my findings: Mr. Tanner was moving transformers inside the PCB Storage Facility in Bldg. 659 and probably did come in contact with Transformer Oil. Fisher and Wilson said the transformers Tanner was moving and handling had all been tested for PCBs and contained less than 50 ppm PCBs. Wilson recommended safety procedures to be implemented by Environmental Services and Supply Division for worker protection in handling the transformers in Bldg. 659.

I asked Fisher to show me the official PCB records. He showed me a listing of "PCB transformers in storage at Tooele Army Depot," dated January 21, 1981. The list contains transformer make, serial number, a sample number, locations, and level of PCB contamination. He also showed me the lab results for the 1929 transformers in storage in Bldg. 659 at Tooele. I asked for and received copies of these documents by mail on October 22, 1981 (see attachment). I also received a copy of Walker's monthly PCB Storage Facility inspection checklist, which indicates he inspects the PCB Storage Facility and its contents monthly (see attachment).

We all went to Bldg. 659, which contains Tooele's PCB Storage Facility. There was no PCB mark on the exterior of building. At Door 19 was an oil stain about 6 foot across. This oil stain was the source of Soil Sample #JK1960, which contained no detectable PCBs (see attachment). This oil spill is the same, which is the object of two of our complaints. Fisher said the oil spilled out of a transformer while it was being moved into the Storage Facility. Inside Building 659 is the PCB Storage Facility. The building had adequate roof, walls, and the floor had been sealed with an epoxy sealer. The PCB storage area of this building is 180 feet wide, 250 feet long, and surrounded by an 8-inch berm. The berm is constructed of smooth concrete and is continuous except at Door Number 17. 20 feet inside Door 17, the berm is broken and crumbled in three or four spots (see photo attachment). Fisher said this damage is from the impact of heavy equipment moving over the berm to move transformers. Walker noted in his records the berm was broken on his inspection of 9/18/81, and he advised Mr. Allen to submit a work order for repair of the berm. Allen supplied me with a copy of the work order for the repair which he submitted 10/2/81 (see attachment number 11).

Inside Door 17 of Building 659 and setting outside the PCB storage area were three large "Standard Transformers," Serial Numbers 38169, 38170, and 38168. All three transformers were 500 kva, and contained 254 gallons of Pyranol. All three transformers had large PCB marks and were setting on wooden palates and not leaking. Allen and Fisher said those transformers had set there at least since April. Neither man had noticed those PCB transformers were setting outside the PCB storage area.

PCB Inspection (PCB82-1)
Tooele Army Depot, Tooele, UT
Page 3

Inside the PCB storage area were, according to Fisher, 1,929 transformers. The sample records indicate the contents of the storage facility is 1,438 transformers or 74.42% non-PCB, 439 transformers or 22.73% PCB contaminated, and 52 transformers or 2.85% PCB. All the PCB transformers I checked were not leaking, and had large PCB marks. I checked 30 to 40 transformers, and all of them were stenciled with a sample number and code letter indicating level of contamination. The code is the lettering system to indicate PCB level: "A" is 0 to 49 ppm PCB, "B" is 50 to 499 ppm PCB, and "C" is 500 and up ppm PCB. I asked Fisher and Thompson to explain the final disposition of these transformers. Fisher said all non-PCB transformers would be shipped to Hill Air Force Base, to be rebuilt. PCB and PCB contaminated transformers were going to be held in storage. No determination had been made about disposal or reuse of the transformers.

I gave Mr. Fisher a verbal Preliminary Notice of Inspection because the Base Commander wanted the form mailed to him. I gave him the following summation.

- Official PCB records were incomplete
- PCB storage facility was not marked
- 3 large PCB transformers were outside the PCB storage facility
- Berm in PCB storage facility was broken.

Paul W. Hanneman
Consumer Safety Officer

Attachments:

1. Notice of Inspection
2. Receipt for Sample
3. Confidentiality Notice
4. Preliminary Results of Inspection Spill Report
5. Spill Report
6. U.S. Army Lab Results Book
7. U.S. Army Investigation Report
8. PCB Records
9. PCB Checklist of PCB Storage Facility
10. 2 Letters to U.S. Army
11. Copy of PCB Storage Facility Repair Work Order
12. U.S. Army Sample Results Letter

BAH-TS:HANNEMAN:bmw:11/13/81



DEPARTMENT OF THE ARMY

TOOELE ARMY DEPOT
TOOELE, UTAH 84074

REPLY TO
ATTENTION OF:

SDSTE-ASF

25 NOV 1981

Mr. Paul W. Hanneman
Consumer Safety Officer
U. S. Environmental Protection Agency
Region VIII
1860 Lincoln Street
Denver, CO 80295

Dear Mr. Hanneman:

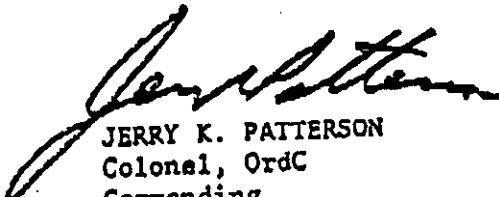
Reference is made to your letter dated October 21, 1981, regarding your PCB inspection conducted on October 14, 1981 (copy attached).

The following measures have been taken regarding your inspection results of probable violations of EPA regulations concerning PCBs:

- a. PCB records are now complete as per Federal Register, Thursday, May 31, 1979, Section 761.45.
- b. PCB storage facility now has PCB warning signs on four sides of building.
- c. The three large PCB transformers have been moved inside the storage facility.
- d. The containment berm which was broken has been repaired.

If you have any questions regarding the above information, please contact Larry Fisher, Environmental Coordinator, Tooele Army Depot, (801) 335-2891.

Sincerely,


JERRY K. PATTERSON
Colonel, OrdC
Commanding

1 Incl
As stated

CF:
Cdr, DESCOM, ATTN: DRSDS-EF w/incl
Cdr, DARCON, ATTN: DRCIS-A w/incl
Dir f/Supply w/incl

October 21, 1981

REF: SAH-TS

Commander
U.S. Army Environmental Hygiene Agency
Aberdeen Proving Grounds, MD 21010

Attention: HSE-RP-ID (Sandy Ehrhardt)

Dear Ms. Ehrhardt:

I recently conducted a PCB Inspection at Tooele Army Depot in response to a complaint our office received about alleged PCB spills. Mr. Larry Fisher, the Environmental Coordinator at Tooele, said he had taken soil samples from the spill areas and sent to your Lab for analysis for PCBs. He also said he received a verbal report from your office that the Lab results indicated the soil samples from the area to contain less than 50 ppm PCB.

Would you please send me a copy of the Lab report for sample numbers JK1979 and JK1960. Thank you for your cooperation and if you have questions, please call me at (303) 837-6231.

Sincerely,

Paul W. Hanneman
Consumer Safety Officer

SAH-TS:HANNEMAN:bmw:10/21/81



DEPARTMENT OF THE ARMY MS EHRHARDT/coh/AUTOVON
U. S. ARMY ENVIRONMENTAL HYGIENE AGENCY 584-3613
ABERDEEN PROVING GROUND, MARYLAND 21010

HSE-RP-MO

3 NOV 1981

SUBJECT: Results of Laboratory Analysis for Tooele Army Depot, Tooele, Utah

Director
US Environmental Protection Agency
Region VIII
ATTN: 8AH-TS (Paul W. Hanneman)
1860 Lincoln Street
Denver, CO 80295

1. References.

- a. Letter, 8AH-TS, your Agency, 21 October 1981.
 - b. Telephone conversation between Ms. Sandra Ehrhardt, this Agency, and Mr. Paul W. Hanneman, your Agency, 29 October 1981, subject as above.
2. In response to your request, results are attached as the Inclosure.
3. Further questions regarding these analyses may be directed to Ms. Sandra Ehrhardt, Commercial (301) 671-3613/4131.

FOR THE COMMANDER:

1 Incl
as

JOSEPH T. WHITLAW, JR.
COL, MSC
Director, Radiation and
Environmental Sciences

HSE-RP-MO

68-082

SUBJECT: Results of Laboratory Analysis for Tooele Army Depot, Tooele, Utah

TABLE. Results of Analysis.

<u>TOOELE ARMY DEPOT SAMPLE NO.</u>	<u>USAEHA NO.</u>	<u>PCB RESIDUE (ppm)</u>
JK 1960	SP 5261	ND*
JK 1979	SP 5279	28

*Not detectable. The lower limit of detectability for PCBs in these soil samples is 1 $\mu\text{g/g}$ (ppm).

